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INSTRUCTION MANUAL

INSTRUCTION MANUAL
FOR
UNIVERSAL TONE GENERATOR
MODEL TG–1

MANUAL NO. 1–500783–261
(For use with Serial No.'s 301 and above)

TG–1/1E/TG–1EP

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NOTICE – A patent is pending on the circuits and concepts used in this instrument.

MANUAL CHANGES
SEE ADDENDUM(S) AT
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5. Approximate number of hours in use.
6. Has maintenance action been previously requested.
7. Other comments.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

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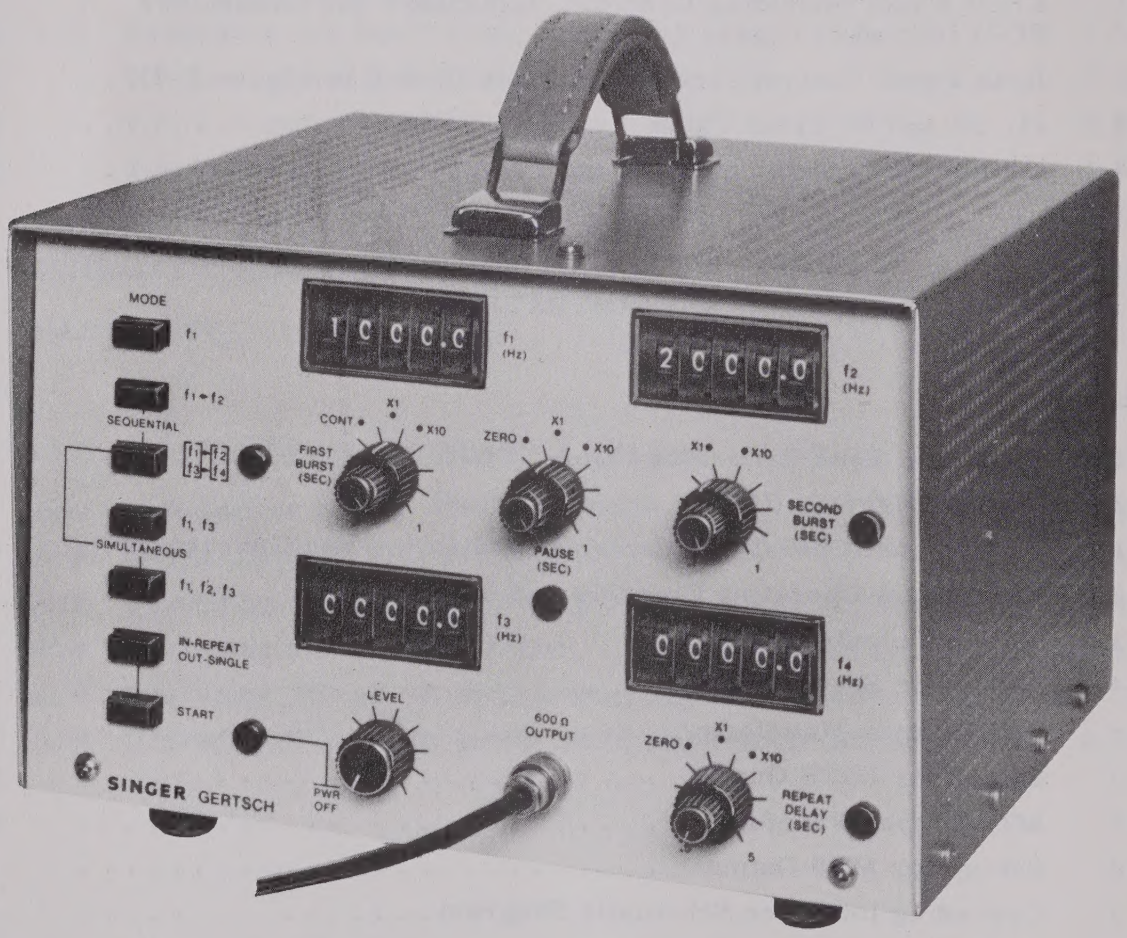


Figure 1-1. Universal Tone Generator, Model TG-1

Section I

INTRODUCTION

1.1 GENERAL

The Universal Tone Generator, Model TG-1, is an accessory for use with any signal generator capable of FM or AM modulation. It equips the generator to service tone-selective communications equipment such as paging units and paging receivers with selective tone code circuitry and decoders.

1.2 TONE FORMATS

The TG-1 generates frequencies from 0.1 Hz to 9999.9 Hz in all varieties of tone formats required for tone-selective testing. The various tone formats available are shown in Table 1-1. A typical timing diagram is illustrated in Figure 1-2 showing the tone relationships between two sequential tone bursts. Timing controls are provided for controlling the duration of each tone burst, the pause between bursts and the delay between repeated cycles. All tones in the TG-1 are derived from a crystal oscillator with an accuracy of ±50 ppm. Output level can be varied from zero to 3V peak to peak. Provision is made for individual adjustment of tone levels.

1.3 MODELS AVAILABLE

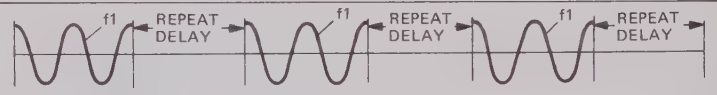
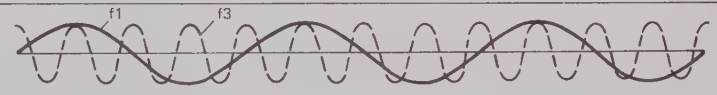
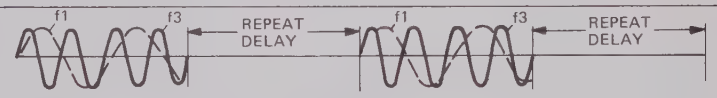
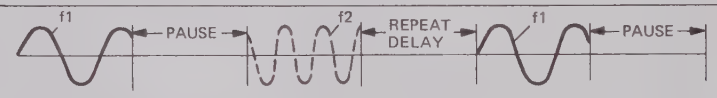
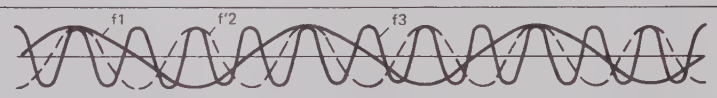
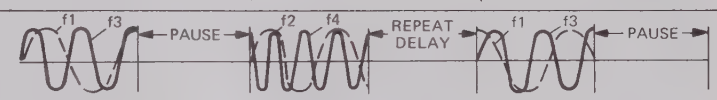
Six variations of the TG-1 are available:

TG-1A
TG-1B
TG-1C
TG-1AP
TG-1BP
TG-1CP

PROGRAMMABLE

The most complete unit is Model TG-1CP. It has all the functions described in this manual, including remote programming capability. Three frequency synthesizer boards (A1, A2 and A3) are included.

Table 1-1. Tone Formats

MODE SWITCH SELECTED	NO. TONES	TIME FORMAT	PICTORIAL REPRESENTATION
f1	1	CONTINUOUS	
f1	1	BURSTS	
f1, f3	2	CONTINUOUS/ SIMULTANEOUS	
f1, f3	2	BURSTS/ SIMULTANEOUS	
f1 → f2	2	SEQUENTIAL BURSTS	
f1, f'2, f3	3	CONTINUOUS/ SIMULTANEOUS	
f1, f'2, f3	3	BURSTS/ SIMULTANEOUS	
[f1 → f2] [f3 → f4]	4	SEQUENTIAL BURSTS	

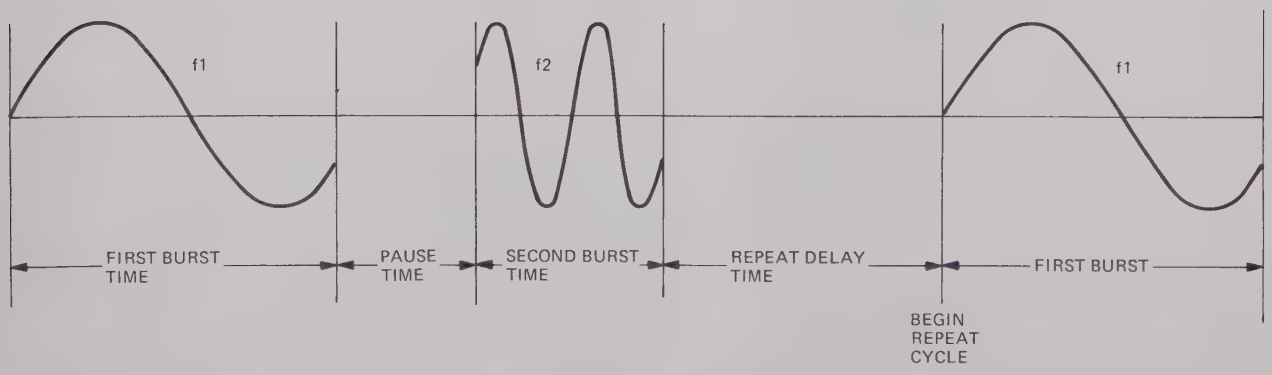


Figure 1-2. Timing Diagram (f1 → f2 Mode Selected)

TG-1A

This model is not capable of supplying two or three tones simultaneously. However it will supply two sequential tone bursts of different frequencies (f1 → f2). It will also supply a single tone continuously or in single tone bursts. The TG-1A contains only one frequency synthesizer board (A3) and two thumbwheels (f3 and f4 are omitted). Integrated circuits AR1 to AR5 are also omitted from assembly A4.

TG-1B

This model will perform all the functions of the TG-1C except three tones simultaneous (f1, f'2, f3).

TG-1C

This is the basic model with all functions except programmability.

TG-1AP

Same as TG-1A with remote programmability.

TG-1BP

Same as TG-1B with remote programmability.

TG-1CP

Same as TG-1C with remote programmability.

1.4 APPLICATIONS

The TG-1 can be used to test a wide variety of tone-selective systems.

EXAMPLES:

Private Line** (continuous tone on RF carrier)
Tone Alert (1 tone burst)
Bellboy* (3 tone simultaneous)
Quik-Call** (2 → 2 sequential)
Sel-Call** (2 → 2 sequential)
Secode*** (2805 Hz interrupted)
and others

* Bell System trademark
** Motorola trademark
*** Secode Electronics trademark

Table 1-2. Specifications

Parameter	Characteristic
Frequency range:	0.1 Hz to 9999.9 Hz
	(Low frequency 3 dB point less than 20 Hz with 600 ohm load)
Accuracy:	±50 ppm, crystal controlled
Resolution:	0.1 Hz
Output:	Sinusoidal; impedance: 600 ohms nominal. Output amplitude for single frequency variable from 0 to 3V p-p ±10% continuous (no-load). Distortion 5% max. Typically 2.5% at 25°C.
Modes available:	One-tone continuous (1)
	One-tone burst (1)
	Two-tone continuous (2) (TG-1B, TG-1C)
	Two-tone burst sequential (1→1)
	Four-tone burst sequential (2→2) (TG-1B, TG-1C)
	Three-tone simultaneous (3) (TG-1C)
Timing ranges:	
First burst:	Continuous, 0.1 to 1 sec., 1 to 10 sec.
Pause:	Zero, 0.1 to 1 sec., 1 to 10 sec.
Second burst:	0.1 to 1 sec., 1 to 10 sec.
Repeat delay:	Zero, 0.5 to 5 sec., 5 to 50 sec.
Power requirements:	115/230V ac, 50 to 400 Hz 12-16V dc, 3A (max)
Temperature:	-5°C to +50°C
Size:	10" W × 7" H × 12" D (approx)
Weight:	12 pounds (approx)
Fuses:	ac and dc
Options:	Remote frequency programming BCD (8, 4, 2, 1)
Accessories (Supplied):	12 Foot dc power cable Instruction Manual

Section II

OPERATING INSTRUCTIONS

2.1 INTRODUCTION

Check the instrument mechanically for signs of damage, loss of hardware such as knobs, etc.

Check the instrument electrically by performing the performance check procedure presented in Section IV.

To prepare for use, simply plug into an ac source and turn on power switch. For dc source use J4 connector on the rear panel.

Operation of the Universal Tone Generator, Model TG-1 is extremely simple. It may be operated entirely from the front panel controls and requires no calibration before use.

The Instrument has numerous operating modes which enables it to be used for testing most proprietary tone-selective systems such as: Bellboy (Bell System trademark), Quik-Call/Sel-Call/Private Line (Motorola trademarks), Secode (Secode Electronics trademark), Tone Alert, etc.

Front and rear panel operating controls, indicators and connectors are described fully in Tables 2-1 and 2-2.

2.2 MODES OF OPERATION

There are three basic modes of operation: continuous, single burst and sequential bursts. Each of these modes may include more than one tone. The complete matrix of modes is displayed in Table 1-1.

2.3 TURN-ON TRANSIENTS

The TG-1 may emit an undesired signal for a one cycle period when the power is first applied. The existence of an undesired output is indicated when more than one of the four indicator lights are lit simultaneously.

This condition will last for the total time settings of the four time controls and will clear automatically. To prevent this spurious first cycle from reaching the

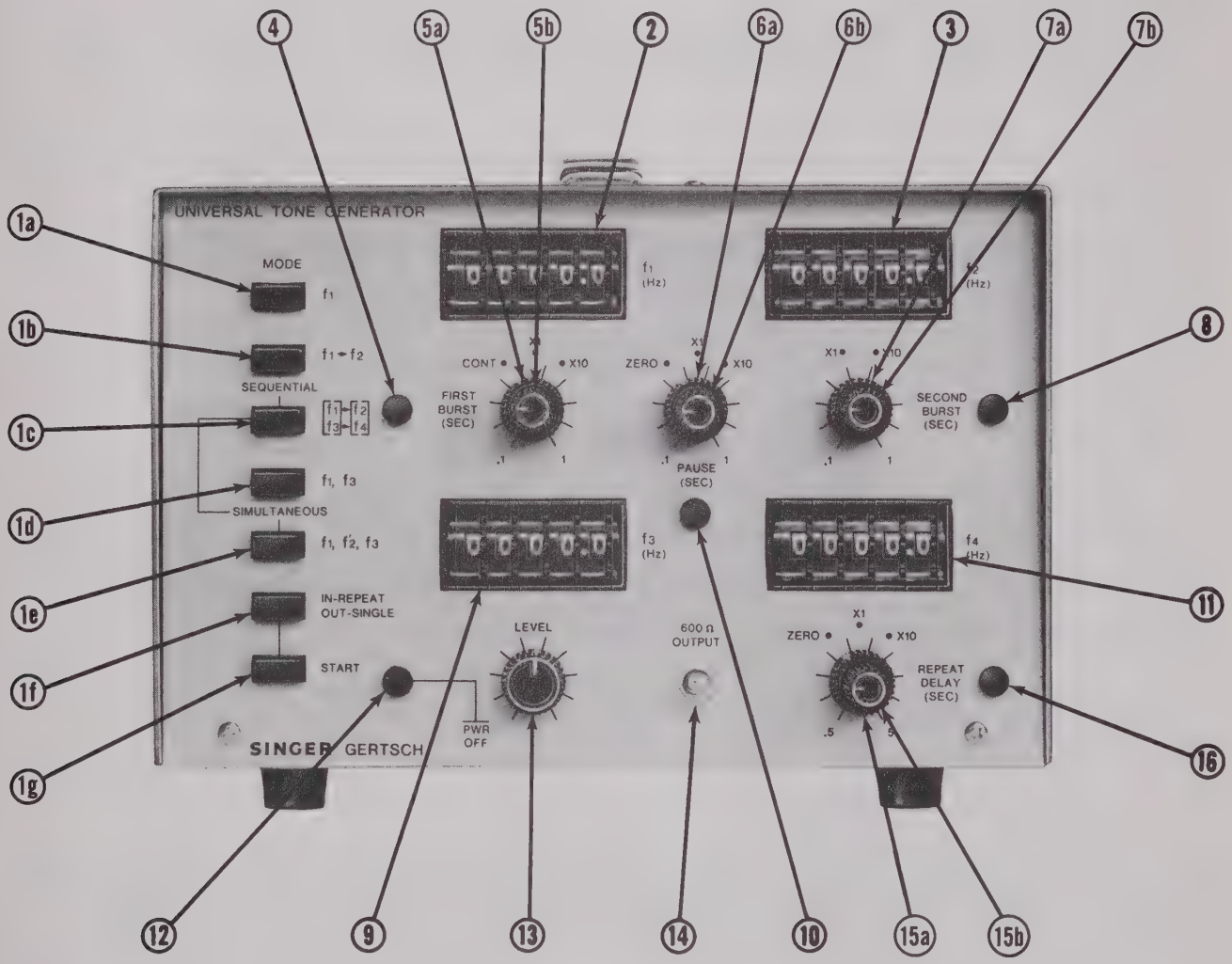


Figure 2-1. Front Panel Operating Controls, Indicators and Connectors

Table 2-1. Front Panel Operating Controls, Indicators and Connectors, TG-1 (Keyed to Figure 2-1)

ITEM	PANEL MARKING	DESCRIPTION	FUNCTION
1	MODE		
1a	f1	Switch, push-push	Only f1 appears at the output when this mode is selected. Duration is controlled by FIRST BURST control (Item 5).
1b	f1 → f2 (SEQUENTIAL)	Switch, push-push	In this mode, f1 appears at the output for a duration controlled by FIRST BURST control (Item 5) followed by a pause controlled in duration by PAUSE control (Item 6) followed in turn by f2 controlled in duration by SECOND BURST control (Item 7). NOTE: if FIRST BURST control is at CONTinuous, f1 will appear continuously.
1c	[f1] → [f2] [f3] → [f4] (SEQUENTIAL)	Switch, push-push	In this mode, f1 and f3 appear at output simultaneously both for the same burst duration controlled by FIRST BURST control. They are followed by a pause followed by f2 and f4 simultaneously for a duration controlled by SECOND BURST control.
1d	f1, f3 (SIMULTANEOUS)	Switch, push-push	In this mode, f1 and f3 appear at output simultaneously. Duration is controlled by FIRST BURST control.
1e	f1, f'2, f3 (SIMULTANEOUS)	Switch, push-push	In this mode f1, f'2 and f3 appear at output simultaneously. Duration is controlled by FIRST BURST control.
1f	IN-REPEAT OUT-SINGLE	Switch, push-push	At IN position, the selected tone mode will repeat continuously with a repeat delay controlled by REPEAT DELAY (Item 15). At OUT position, the tone mode selected will not repeat. To obtain another tone cycle, the START switch (Item 1g) must be pressed.
1g	START	Switch, push-push	This switch initiates the tone cycling operation of the instrument in both SINGLE and REPEAT modes.
2	f1 (Hz)	Switch, thumbwheel	Selects frequency, f1, from 0.1 Hz to 9999.9 Hz.
3	f2 (Hz)	Switch, thumbwheel	Selects frequency, f2.
4		Light, indicator	Indicates when FIRST BURST appears at output, for duration of burst.
5a	FIRST BURST (SEC) CONT X1 X10	Switch, rotary, 3 position	In CONT position, first burst is continuous. In X1 position, calibration is in seconds as marked. In X10 position, scale markings multiplied by 10.
5b	.1 1	Potentiometer	Controls tone burst duration from 0.1 to 1 sec or from 1 to 10 secs.

Table 2-1. Front Panel Operating Controls, Indicators and Connectors, TG-1 (Keyed to Figure 2-1) - Continued

ITEM	PANEL MARKING	DESCRIPTION	FUNCTION
6a	PAUSE (SEC) ZERO X1 X10	Switch, rotary, 3 position	In ZERO position, pause is zero. In X1 position, calibration is in seconds In X10 position, calibration is multiplied by 10.
6b	.1 1	Potentiometer	Controls pause from 0.1 to 1 sec or from 1 to 10 secs.
7a	SECOND BURST (SEC) X1 X10	Switch, rotary, 2 position	In X1 position, calibration is in seconds as marked.
			In X10 position, scale markings multiplied by 10.
7b	.1 1	Potentiometer	Controls tone burst duration from 0.1 sec to 1 sec or from 1 sec to 10 secs.
8		Indicator Light	Indicates when SECOND BURST appears at output, for duration of burst.
9	f3 (Hz)	Switch, thumbwheel	Selects frequency f3.
10		Light, indicator	Indicates pause duration between sequential bursts.
11	f4 (Hz)	Switch, thumbwheel	Selects frequency f4.
12	PWR OFF	Light, indicator	Indicates power "ON" condition.
13	LEVEL	Potentiometer	Controls output level.
14	600 OHM OUTPUT	Connector, BNC	Output connector.
15a	REPEAT DELAY (SEC) ZERO X1 X10	Switch, rotary, 3 position	In ZERO position, delay is zero. In X1 position, delay is 0.5 to 5 secs. In X10 position, delay is 5 to 50 secs.
15b	.5 5	Potentiometer	Controls repeat delay duration from 0.5 to 5 sec or from 5 to 50 secs.
16		Light, indicator	Indicates repeat delay duration.

Table 2-2. Rear Panel Controls and Connections
(Keyed to Figure 2-2)

ITEM	PANEL MARKING	DESCRIPTION	FUNCTION
1	AC-DC	Switch, slide	Selects ac or dc operation.
2	115/230V	Switch, slide	Selects 115V or 230V operation.
3	REMOTE PROGRAMMING	Connector, 100 pin	Accepts inputs for remote programming.
4	12V DC	Connector, 4 pin	12V dc input connector.
5	F1	Fuse 3/4A slo-blo Fuse 3/8A slo-blo	Protects ac input circuit (115V) Protects ac input circuit (230V)
6	F2	Fuse 3A slo-blo	Protects dc input circuit
7	J1	Connector, phonejack	Remote telephone dial input] for Secode and IMTS output
8	J2	Connector, phonejack	Remote telephone dial input] for Secode and IMTS output
9	J5	Connector, phonejack	Remote telephone dial input [for MTS output]
10	f1	Potentiometer	Adjusts output level of f1
11	f2	Potentiometer	Adjusts output level of f2
12	f'2	Potentiometer	Adjusts output level of f'2
13	f3	Potentiometer	Adjusts output level of f3
14	f4	Potentiometer	Adjusts output level of f4

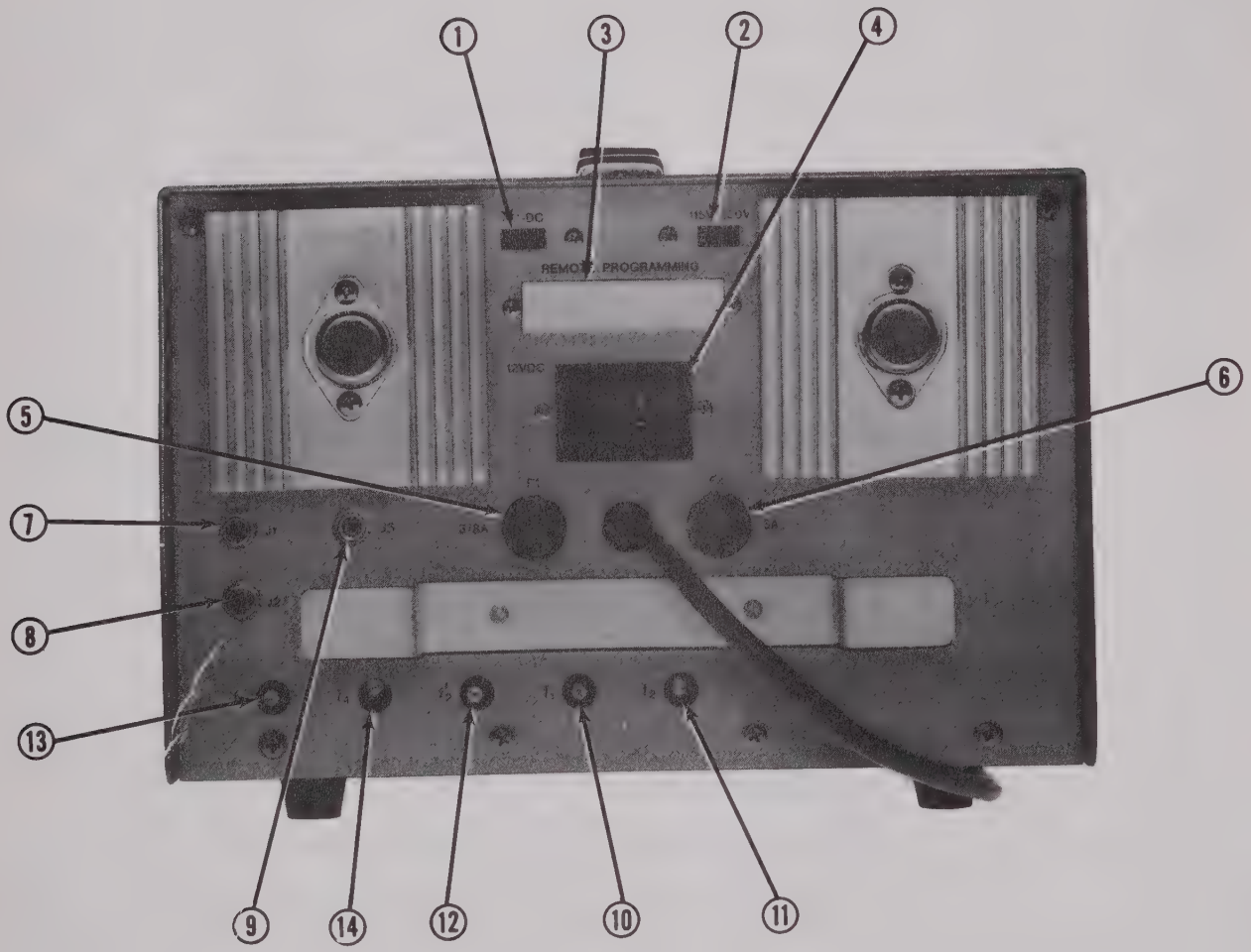


Figure 2-2. Rear Panel Operating Controls and Connectors

external test circuitry, maintain the LEVEL control at maximum ccw position (at which the output level is zero) until all lights are out (except the power light). Since the spurious condition will last for the total time set on the four time controls, the time needed to eliminate the spurious condition may be shortened to 0.2 seconds by setting all four time controls to minimum.

2.4 OPERATING PROCEDURES

2.4.1 Continuous - Single Tone

a. Set controls as follows:

Power (LEVEL Control)	On/Max ccw
MODE f1	In
f1 (thumbwheel)	Desired frequency
FIRST BURST	CONT.

b. Connect 600Ω OUTPUT connector to external test circuit.

c. When all indicator lights are out (refer to paragraph 2-3), adjust LEVEL control for desired output level. Maxium cw position is approximately 0.5 Vrms with a 600 ohm load.

2.4.2 Continuous Two-Tone Simultaneous

Repeat paragraph 2.4.1 except set MODE switch f1, f3 to IN position.

2.4.3 Continuous Three-Tone Simultaneous

Repeat paragraph 2.4.1 except set MODE switch f1, f'2, f3 to IN position.

2.4.4 Single Burst - Single Tone

a. Set controls:

Power (LEVEL Control)	On/Max ccw
MODE f1	In
f1 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. When all indcator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch. Note, all indicator lights must be out before starting.

2.4.5 Single Burst - Two Tone Simultaneous

a. Set Controls:

Power (LEVEL Control)	On/Max ccw
MODE f1, f3	In
f1 (thumbwheel)	Desired frequency
f3 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration

b. Connect 600 Ω OUTPUT connector to external circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

2.4.6 Single Burst - Three-Tone Simultaneous

a. Set controls:

Power (LEVEL Control)	On/Max ccw
MODE f1, f'2, f3	In
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration

b. Connect OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

2.4.7 Sequential Bursts, f1 → f2

a. Set controls:

Power (LEVEL Control)	On/Max ccw
MODE f1 → f2	In
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration
PAUSE	Desired duration
SECOND BURST	Desired duration

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone bursts is required, set REPEAT DELAY to desired duration and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

2.4.8 Sequential Bursts [f1, f3] → [f2, f4]

a. Set controls:

Power (LEVEL Control)	On/Max ccw
MODE [f1, f3] → [f2, f4]	In
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	Desired frequency
f4 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration
PAUSE	Desired duration
SECOND BURST	Desired duration

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output level.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

2.5 SECODE TESTING (REF. TO APPENDIX A FOR UPGRADING TG-1B FOR IMTS, MTS AND SECODE.)

The TG-1C and TG-1CP supply a Secode tone output waveform when an external telephone dial is connected to the rear panel connectors J1 and J2. The output waveform is shown in Figure 2-3.

The set-up procedure is as follows:

a. Set controls:

Power (LEVEL Control)	On/Max ccw
MODE f1	In
f2 (thumbwheel)	Desired frequency

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. Connect telephone dial to J1 and J2 input connectors on rear panel as shown in Figure 2-4.

d. When all indicator lights are out, adjust LEVEL control for desired output level.

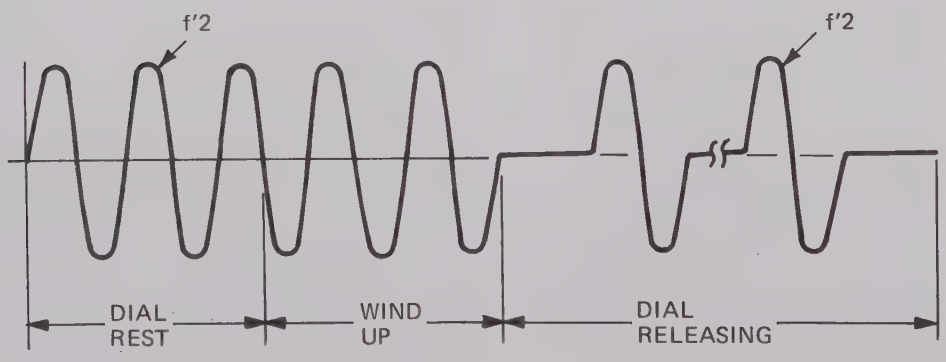


Figure 2-3. Secode Output Waveform

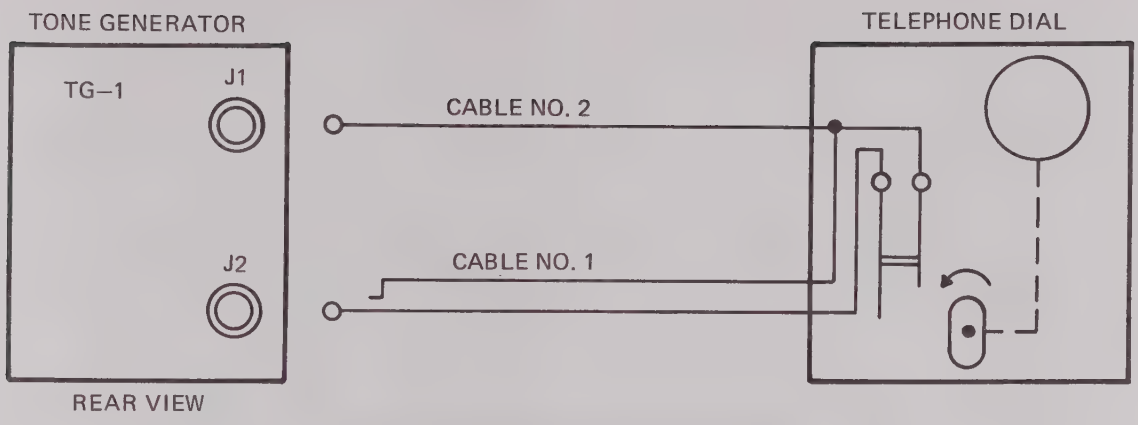


Figure 2-4. Set-up for Secode Output

2.6 IMTS TESTING (REF. TO APPENDIX A FOR UPGRADING TG-1B FOR IMTS, MTS AND SECODE.)

Models TG-1C and TG-1CP can supply an IMTS output waveform when an external telephone dial is connected to rear panel connectors J1 and J2. The output waveform is shown in Figure 2-5.

The set-up procedure is as follows:

a. Set controls:

Power (LEVEL Control)	On/Max ccw
MODE f1	In
FIRST BURST	CONT.
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. Connect telephone dial to J1 and J2 connectors on rear panel as shown in Figure 2-6.

d. When all indicator lights are out, adjust LEVEL control for desired output level.

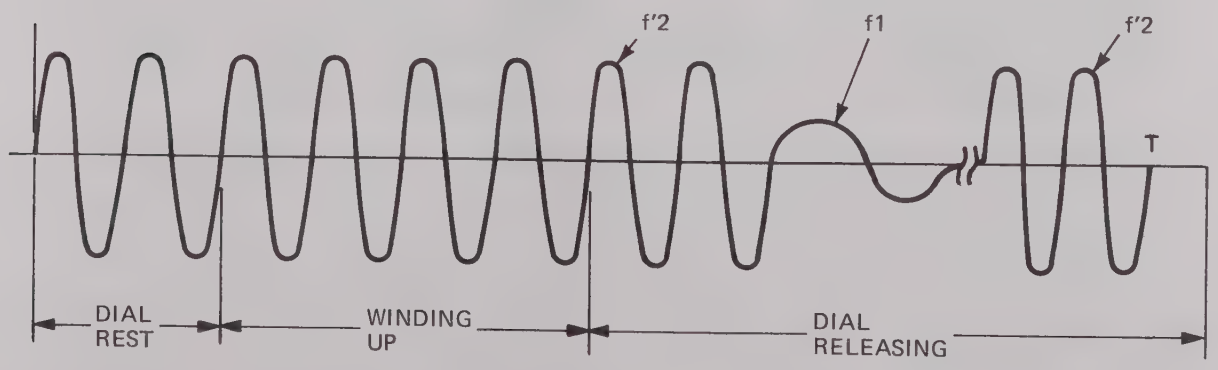


Figure 2-5. IMTS Output Waveform

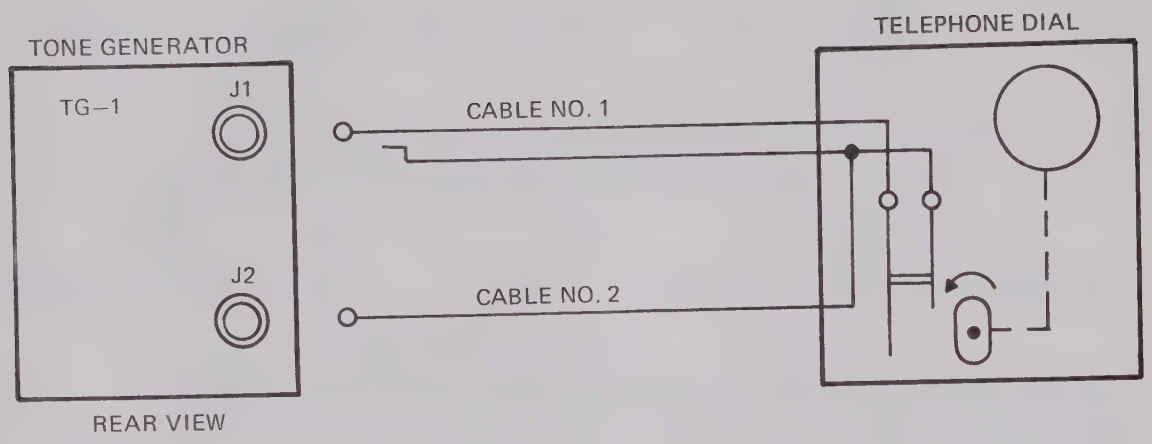


Figure 2-6. Set-up for IMTS Output

2.7 MTS TESTING (REF. TO APPENDIX A FOR UPGRADING TG-1B FOR IMTS, MTS AND SECODE.)

Models TG-1C and TG-1CP supply an MTS output waveform when an external telephone dial is connected to rear panel connectors J5 and J2. The output waveform is shown in Figure 2-7.

The procedure is as follows:

a. Set controls:

Power (LEVEL control)	On/Max ccw
MODE f1	In
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency

b. Connect 600 Ω OUTPUT connector to external test circuit.

c. Connect telephone dial to J5 and J2 connectors on rear panel as shown in Figure 2-8.

d. When all indicator lights are out, adjust LEVEL control for desired output level.

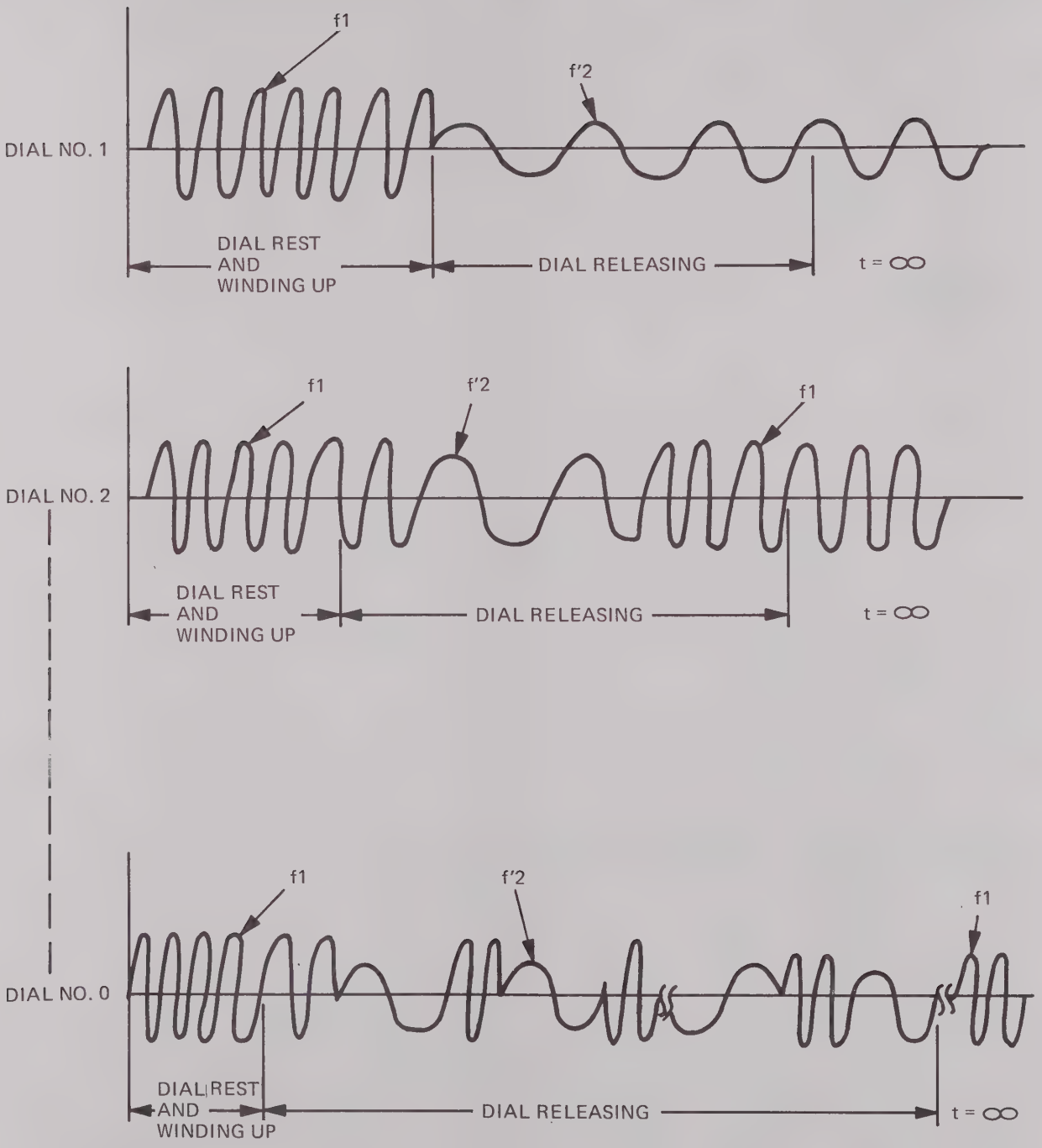


Figure 2-7. MST Output Waveform

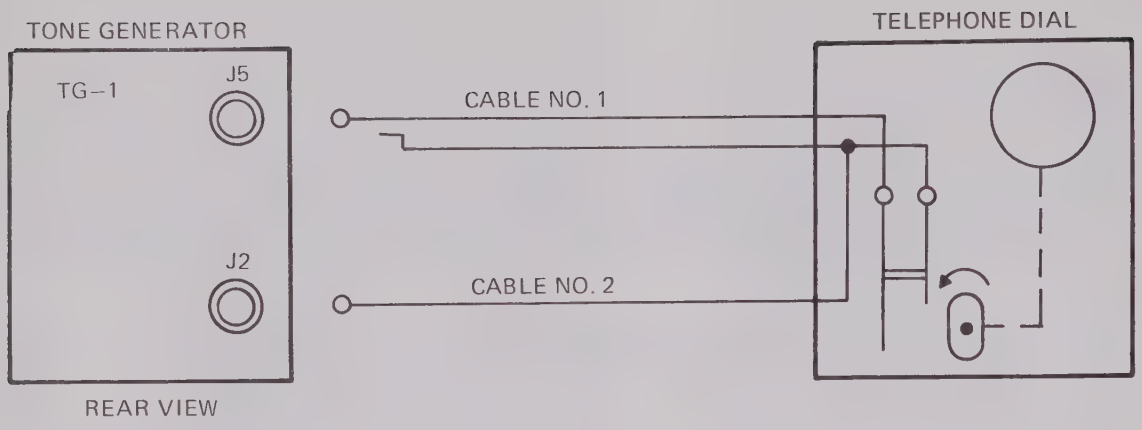


Figure 2-8. Set-up for MTS Output
Refer to Table 2-3 for J1, J2 and J5 Truth Table

Table 2-3. J1, J2 and J5 Truth Table

	J1	J2	J5	OUTPUT
STATIC	OPEN	OPEN	OPEN	f1
	CLOSED	OPEN	OPEN	0
	OPEN	CLOSED	OPEN	f1
	CLOSED	CLOSED	OPEN	f'2
DYNAMIC	OPEN ↕ OPEN	CLOSED ↕ CLOSED	NORMALLY CLOSED (INTERRUPTED BY DIAL)	DIAL #1 f1 → f'2 #2 f1 → f'2 → f1 #3 f1 → f'2 → f1 → f'2 #4 f1 → f'2 → f1 → f'2 → f1 #5 f1 → f'2 → f1 → f'2 → f1 → f'2 #6 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 #7 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 #8 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 #9 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 #0 f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1 → f'2 → f1

2.8 INDEPENDENT TONE LEVEL ADJUSTMENTS

The TG-1 has the capability for independent adjustment of all four tone output levels by means of potentiometers on the rear panel. The instrument is supplied with all tones set to maximum level (1.1 Vrms). However, the gain of each tone circuit may be reduced independently for specific applications. The output levels of all four tones are also controlled simultaneously by the front panel LEVEL control. See Specifications Table 1-2 for electrical output specifications

Note that there are two potentiometers on the rear panel for adjusting f2, one labeled f2, and the other labeled f'2. The f'2 pot is used to set the level of f2 when the f1, f'2, f3 simultaneous mode is selected.

2.8.1 Preliminary Procedure

a. Connect oscilloscope to OUTPUT connector.

b. Set front panel LEVEL control to max cw and maintain it in this position while making the following independent tone level adjustments.

2.8.2 Frequency f1 Level Adjustment

a. Set controls:

MODE f1	In
FIRST BURST	CONT.
f1 (thumbwheel)	Desired frequency

b. Obtain display of frequency, f1, on oscilloscope.

c. Adjust potentiometer, f1, on rear panel until desired level is obtained.

2.8.3 Frequency f2 Level Adjustment

a. Set controls:

MODE f1 → f2	In
FIRST BURST switch	X1
FIRST BURST potentiometer	Max ccw
PAUSE	ZERO
REPEAT DELAY	ZERO
f1 (thumbwheel)	0000.0 Hz
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	0000.0 Hz
f4 (thumbwheel)	0000.0 Hz

SECOND BURST switch	X10
SECOND BURST potentiometer	Max cw
IN-REPEAT/OUT-SINGLE	IN-REPEAT

b. Push START switch

c. Obtain display of frequency, f2, on oscilloscope.

d. Adjust potentiometer, f2, on rear panel until desired level is obtained.

2.8.4 Frequency f3 Level Adjustment

a. Set controls:

MODE f1, f3	In
FIRST BURST	CONT.
f1 (thumbwheel)	0000.0 Hz.
f2 (thumbwheel)	0000.0 Hz
f3 (thumbwheel)	Desired frequency
f4 (thumbwheel)	0000.0 Hz

b. Obtain display of frequency, f3, on oscilloscope.

c. Adjust potentiometer, f3, on rear panel until desired level is obtained.

2.8.5 Frequency f4 Level Adjustment

a. Set controls:

MODE [f1, f3]→[f2, f4]	In
FIRST BURST switch	X1
FIRST BURST potentiometer	Max ccw
PAUSE	ZERO
REPEAT DELAY	ZERO
SECOND BURST switch	X10
SECOND BURST potentiometer	Max cw
f1 (thumbwheel)	0000.0 Hz
f2 (thumbwheel)	0000.0 Hz
f3 (thumbwheel)	0000.0 Hz
f4 (thumbwheel)	Desired frequency
IN-REPEAT/OUT-SINGLE	In

b. Push START switch

c. Obtain display of frequency, f4, on oscilloscope.

d. Adjust potentiometer, f4, on rear panel until desired level is obtained.

2.8.6 Frequency f'2 Level Adjustment

a. Set controls:

MODE f1, f'2, f3	In
FIRST BURST	CONT.
f1 (thumbwheel)	0000.0 Hz
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	0000.0 Hz
f4 (thumbwheel)	0000.0 Hz

b. Obtain display of frequency, f2, (same as f'2) on oscilloscope.

c. Adjust potentiometer, f'2, on rear panel until desired level is obtained.

2.9 REMOTE CONTROL

Models TG-1AP, TG-1BP, and TG-1CP may be programmed with BCD input for frequency selection, and start and stop may be performed remotely via rear panel connector J3. See Table 2-4 for remote control connector pin functions. Note that all thumbwheels must be at 0000.0 Hz for remote frequency control.

2.10 CASCADING

Two TG1's may be connected in cascade to perform 4 sequential bursts, as shown in Figure 2-9. Only programmable units may be cascaded.

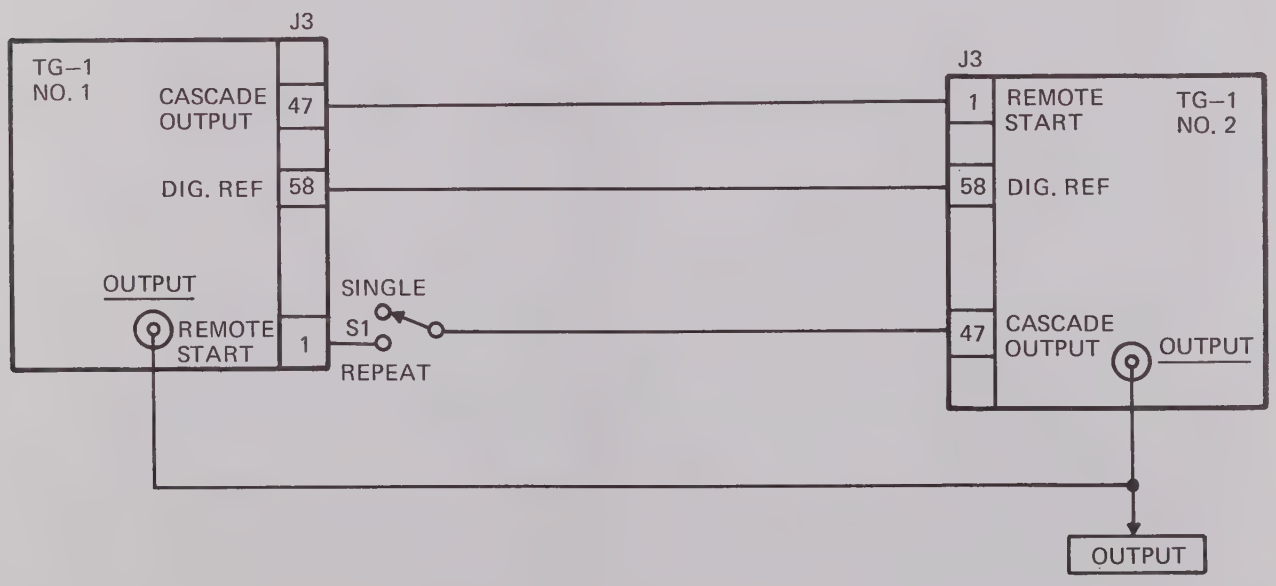


Figure 2-9. Cascading Interface Schematic Diagram

2.10.1 Single Cycle

To generate one sequential cycle of four bursts perform the following:

a. Set toggle switch, S1, to "Single" (open) position.

b. Set switch IN-REPEAT/OUT-SINGLE to the OUT-SINGLE position on both TG-1's.

c. Select desired mode and timing on both TG-1's.

d. Connect output as shown in Figure 2-9.

e. Press the pushbutton switch START on the TG-1 No. 1 only. (see paragraph 2.3).

2.10.2 Repeat Cycle

To obtain cycling operation perform the following:

a. Set switch IN-REPEAT/OUT-SINGLE to the OUT-SINGLE position on both TG-1's.

b. Select desired mode and timing on both TG-1's.

c. Set toggle switch, S1, to "Single" (open) position.

d. Turn on power on both units (see paragraph 2.3).

e. Set toggle switch, S1, to "Repeat" (closed) position.

f. If TG-1 (No. 1) failed to start press pushbutton switch START on TG-1 No. 1 only.

Table 2-4. Remote Control Connections (J3)

FUNCTION	PIN NUMBERS
Digital Common:	Pins 58 and 59
Remote Start: Starts repeat cycling function. Compatible with T^2L logic. Logic "1" = 4 ±1 Vdc Logic "0" = $0^{-0}_{+.5}$ Vdc	Pin 1
Remote Stop: Stops repeat cycling function. Compatible with T^2L logic. Logic "1" = $0^{-0}_{+.5}$ Vdc Logic "0" = 4 ±1 Vdc Output power Available: +12 Vdc + 5 Vdc	Pin 44 Pin 50 Pin 52
Cascade Output:	Pin 47
Spare Pins:	41, 45, 46, 48, 49, 51, 53, 54, 55, 56, 57

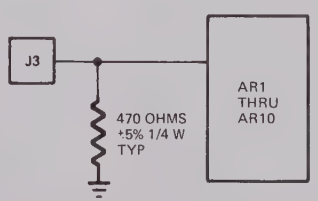
Remote Frequency Programming:

Note: <u>All thumbwheels must be at zero</u>. Interface is not compatible with T^2L logic. Each input has a pull down resistor as shown below:

Input high:

$I_{IH} \simeq 10$ mA

$V_{IH} = +5 \pm 1$ Vdc



Input low: Open or connected to digital common.

Table 2-4. Remote Control Connections (J3)- Continued

Frequency f1			Frequency f2		
PIN	BCD (BINARY)		PIN	BCD (BINARY)	
79	1	10^{+4} (MSD)*	42	1	10^{+4} (MSD)
80	2		43	2	
81	4		21	4	
82	8		22	8	
83	1	10^{+3}	23	1	10^{+3}
84	2		24	2	
85	4		25	4	
86	8		26	8	
87	1	10^{+2}	27	1	10^{+2}
88	2		28	2	
60	4		29	4	
61	8		2	8	
62	1	10^{+1}	3	1	10^{+1}
63	2		4	2	
64	4		5	4	
65	8		6	8	
66	1	10^{-1} (LSD)*	7	1	10^{-1} (LSD)
67	2		8	2	
68	4		9	4	
40	8		10	8	

Frequency f3			Frequency f4		
PIN	BCD (BINARY)		PIN	BCD (BINARY)	
39	1	10^{+4} (MSD)	98	1	10^{+4} (MSD)
38	2		97	2	
37	4		96	4	
36	8		95	8	
35	1	10^{+3}	94	1	10^{+3}
34	2		93	2	
33	4		92	4	
32	8		91	8	
31	1	10^{+2}	90	1	10^{+2}
30	2		89	2	
20	4		78	4	
19	8		77	8	
18	1	10^{+1}	76	1	10^{+1}
17	2		75	2	
16	4		74	4	
15	8		73	8	
14	1	10^{-1} (LSD)	72	1	10^{-1} (LSD)
13	2		71	2	
12	4		70	4	
11	8		69	8	

*MSD = most significant digit
LSD = least significant digit

Section III

THEORY OF OPERATION

3.1 GENERAL

The circuitry of the Tone Generator Model TG-1 falls into two major categories: (1) frequency synthesis circuits and (2) the control logic circuits. The theory of operation for these two groups of circuits provides a comprehensive explanation of the instrument.

3.2 FREQUENCY SYNTHESIS CIRCUITS (Refer to Figure 3-1)

The TG-1 has three identical frequency synthesis boards: A1, A2 and A3. Each board synthesizes a tone by means of a digital counting process and each board has two inputs. One input is the system clock (fo) which is the basic signal source for the derivation of the output tone. It provides an input frequency of 1.98 MHz. The other input is a set of binary coded decimal (BCD) lines (8, 4, 2, 1). These lines determine the output frequency of the synthesizer board and hence of the output tone. The output frequency is given by the equation:

$$f_{output} = Mfo$$

where:

f output = output frequency
M = BCD scale factor
fo = 1.98 MHz

These two inputs control the decade rate scalers (DRS) consisting of AR1 - AR5 on each of the three frequency synthesizer boards A1, A2 and A3. The output from the DRS is applied to a serial-input, digital-to-analog (D/A) converter. This D/A converter consists of an up/down counter (AR7 - AR8) and a BCD ladder network (R4 - R18). The output voltage of the D/A converter represents a staircase signal, each step being proportional to the number of input pulses received from the DRS. When the up/down counter reaches maximum count, the up/down control circuits (AR9/AR10) switch the counter from up to down counting. Wnen the counter reaches zero, the up/down control commands it to reverse itself and count upwards. Thus the output of the D/A converter is a positive staircase triangular waveform.

This positive triangular waveform is applied to negative-biased input amplifier, AR11. The output of this amplifier is a symmetrical triangular function. The triangle waveform is further converted into a sinewave through triangle-to-sine converter Q1.

3.2.1 Multiplexing

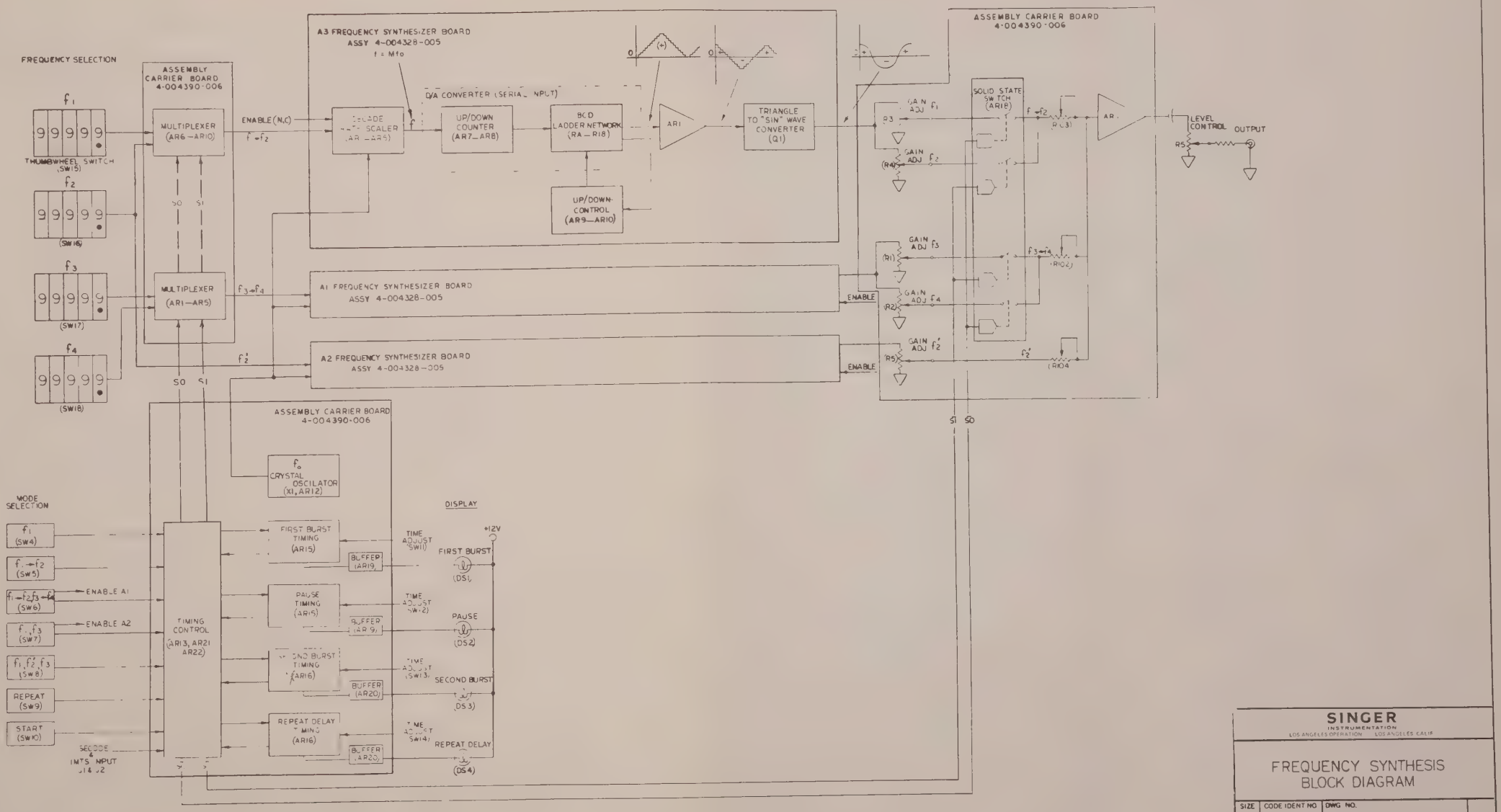
Frequency synthesizer boards A1 and A3 are capable of receiving two frequency selections by means of a multiplexer. A3 frequency synthesizer board can receive f1 or f2 frequency control lines from the thumbwheel switches through multiplexer AR6 - AR10. A1 frequency synthesizer board can receive f3 or f4 frequency control lines from the thumbwheel switches through multiplexer AR1 - AR5. A2 frequency synthesizer board does not have a multiplexing input. Each frequency board also has one enable input which is used in mode selection. A3 frequency synthesizer board is enabled at all times.

3.2.2 Output

The output of each frequency board has a fixed gain determined by amplifier AR11. Provision is made for adjusting the gain of each frequency (f1, f2, f'2, f3 and f4). This can be accomplished by adjusting potentiometers R1 - R5 located on the carrier board, A4, and they are accessible via the rear panel. The signal then is applied to solid state switch, AR18, which is controlled by timing control lines $\overline{S0}$ and $\overline{S1}$. The output of AR18 is connected to the input of A4AR11. When $\overline{S0}$ and $\overline{S1}$ control lines select frequency, f1, to go through the multiplexer and control A3 frequency synthesizer board, at the same time control lines $\overline{S0}$ and $\overline{S1}$ will turn on the gate connected to potentiometer, R3. The second gate connected to potentiometer, R4, will be open. Therefore the position of R3 will determine the output of amplifier A4AR11. If f2 frequency is selected, the second gate will be closed and the first open. Potentiometer, R4, will then determine the output of the amplifier. In other words, the solid state switch serves as a demultiplexer to allow a different gain for each selected frequency.

The output of A2 frequency synthesizer board (f'2) may be adjusted with potentiometer A4R5. Potentiometers R102, R103 and R104 are adjusted for calibration purposes only.

Overall level control is adjusted by front panel potentiometer LEVEL control (R5).



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FREQUENCY SYNTHESIS
BLOCK DIAGRAM

SIZE	CODE IDENT NO	DWG NO.
D	88869	4-501252-001

SCALE SHEET OF

Figure 3-1. Frequency Synthesis, Block Diagram

3.3 CONTROL LOGIC CIRCUITS

Control logic circuits are used to perform the following functions:

a. To generate timing for bursts, pause, and repeat delay. (Multiplexing through lines S0 and S1 and demultiplexing through lines $\overline{S0}$ and $\overline{S1}$).

b. To select mode of operation.

c. To determine single or repeat operation.

d. To perform the start function.

e. To provide buffering for indicator lights.

3.3.1 Timing Circuits

Each of the functions; first burst, pause, second burst, and repeat delay has a separate timing circuit (on integrated circuits AR15 and AR16). Time durations are controlled by front panel controls SW11, SW12, SW13, and SW14. All four timing circuits are connected sequentially. Each one activates the following delay circuit at the completion of its own timing cycle. Some timing may be by-passed, depending on the mode selected. The timing circuits also drive the indicator lights through buffers AR19 and AR20.

3.3.2 Modes of Operation

The mode-selection push-button switches and timing circuits are interconnected in such a way as to perform the desired functions. For example: If mode f1, f'2, f3 is selected, the circuit enables A1, A2, and A3 frequency synthesizer boards and allows the first burst to be generated (f1, f'2, f3). The second burst circuit is by-passed and therefore disabled.

3.3.3 Repeat Cycling Circuits

The control logic cycling circuit determines when the first burst should be initiated again in the automatic repeat mode. The trailing edge of the repeat delay pulse from timing circuit AR16 initiates the first burst in the repeat mode or stops cycling in the single cycle mode. (Time for one cycle = first burst time + pause time + second burst time + repeat delay time).

3.3.4 Start Circuit

This circuit (AR22) initiates the first burst timing cycle when pushbutton START is pressed. The "Start" function is also available on the rear connector (J3) (T^2L compatible).

3.3.5 Stop Circuit

This circuit is part of start/stop circuit (AR21, AR22). To stop cycling in the repeat mode set IN-REPEAT/OUT-SINGLE switch to the OUT-SINGLE position. On programmable units, the stop function is also available on the rear connector (J3).

Section IV

MAINTENANCE

4.1 INTRODUCTION

The Universal Tone Generator Model TG-1 is calibrated at the factory and should be recalibrated every six months. Procedures are given in this section for adjusting the distortion of the frequency synthesizer boards, adjusting the timing circuits, and adjusting the power supply. All three frequency synthesizer boards are identical but will require realignment if they are removed and re-installed in different connectors. They are calibrated at the factory for minimum distortion.

4.2 TEST EQUIPMENT

The following instruments are required for calibration and re-alignment:

a. Oscilloscope, Tektronix Model 543B or equivalent with 10X Probe.

b. Resistor decade box, (100-500K).

c. Distortion meter, HP331A, or equivalent.

d. 44 pin extender board Singer (P/N 4-103189-001), or equivalent (optional).

e. Voltmeter, Triplett 630-A or equivalent.

f. Counter, HP 5532A or equivalent.

4.3 POWER SUPPLY ADJUSTMENT

Only the +10V dc supply is adjustable. The -10V dc is adjusted automatically by adjustment of the +10V dc supply. Connect the voltmeter to AR17-4 on Carrier Board, A4, and check that the voltage is +10V dc. If it is not +10V dc, adjust potentiometer R10.

4.4 TEST AND ADJUSTMENT PROCEDURES FOR FREQUENCY SYNTHESIZER BOARDS

4.4.1 Frequency Synthesizer Board, A1

4.4.1.1 Triangularity Check

a. Install extender board (if available) in place of A1 and connect A1 into the extender.

b. Turn on power to the TG-1 and set LEVEL control to max CW.

c. Push MODE switch f1, f3 to IN position.

d. Set FIRST BURST switch to CONT.

e. Connect oscilloscope 10X probe to output of amplifier AR11-10 or R28.

f. Set thumbwheel f3 to 9000.0 Hz.

g. The output should be triangular as shown in Figure 4-1. If the waveform is broken as shown in Figure 4-2, the digital-to-analog converter is not functioning uniformly for all bits, and the following adjustment procedure should be performed.

4.4.1.2 Triangularity Adjustment Procedure. The following procedure is intended to correct the type of break illustrated in Figure 4-2. While other break points are possible, a fault is most likely to appear at the point shown. The numbers shown in Figure 4-2 correspond to the bit weight of the most significant decade. Bit 8 is the most significant bit in an 8, 4, 2, 1 BCD code. For this reason a fault is most likely to be evident at point 8 and bit 8 is most likely to have a negative error, as shown. To bring bit 8 back to its proper value so that the waveform follows the dashed line, the effective resistance across R18 and R34, which are in parallel must be reduced, proceed as follows:

a. Remove R34.

b. Connect a decade resistance box across R18.

c. Adjust the resistance box until the proper triangular wave is obtained.

Figure 4-1. Correct Triangular Output Waveform

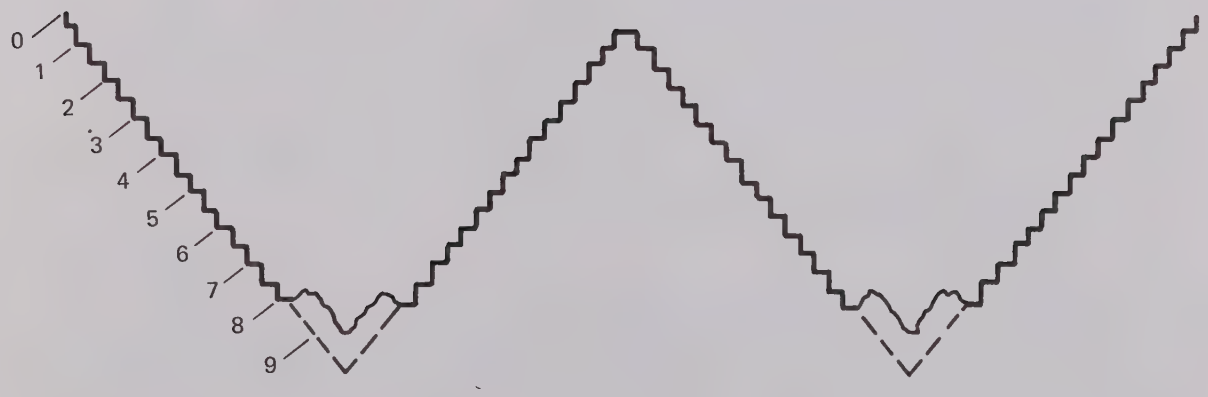


Figure 4-2. Incorrect Output Waveform

d. Select a standard resistor closest in value to the setting of the resistance box and solder it in place of R34.

e. Proceed to the following distortion test and adjustment procedure.

4.4.1.3 Distortion Check and Adjustment

a. Connect the distortion meter to the TG-1 output.

b. Set thumbwheel, f3, to 9000.0 Hz.

c. Set distortion meter frequency range to X1K position.

d. Connect oscilloscope to distortion meter output.

e. Obtain a display of the distortion meter output on the oscilloscope and observe that it is sinusoidal. If it is not, adjust potentiometers R22 and R24 on A1 as follows until the waveform is sinusoidal.

f. If the distortion meter reading is greater than 5%, adjust R22 for minimum distortion then adjust R24 for minimum distortion. (Check the distortion analyzer input level).

g. Adjust R22 for minimum distortion and then R24.

h. Repeat step g until distortion is less than 5% (typical value 2.5%).

i. Using the oscilloscope, adjust R103 on the Carrier Board, A4, for an output level of 1.1 Vrms ±2% (approximately 3V p-p).

4.4.2 Frequency Synthesizer Board, A2

a. Repeat paragraph 4.4.1.1 steps a through g, except use MODE f1, f'2, f3 at step c and set thumbwheel, f2, to 9000.0 Hz at step f.

b. Repeat paragraph 4.4.1.2 steps a through e and paragraph 4.4.1.3 steps a through i, except adjust R104 at step i.

4.4.3 Frequency Synthesizer Board, A3

a. Repeat paragraph 4.4.1.1 steps a through e, except use MODE f1 at step c and set thumbwheel, f1, to 9000.0 Hz at step f.

b. Repeat paragraph 4.4.1.2 steps a through e and paragraph 4.4.1.3 steps a through i, except adjust R102 at step i.

4.5 TIMING CHECK AND ADJUSTMENT PROCEDURES

4.5.1 First Burst (set pause, second burst, and repeat delay to minimum)

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1→f2 to In position.

c. Push START switch to begin cycling.

d. Turn FIRST BURST switch to X1 position.

e. Turn FIRST BURST control to max ccw position.

f. Connect oscilloscope probe to terminal E18 (amp terminal) on front of Carrier Board, A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to the reference voltage (0V) should be 0.1 second. If it is not, adjust R6 on A4.

h. Turn FIRST BURST control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 1.0 second ±20%. If the pulse width is less than 0.8 seconds, replace capacitor C1 on A4. If the pulse width is greater than 1.2 seconds, add a resistor across FIRST BURST control of such a value that it will shorten the pulse to within the specified timing range.

j. Set FIRST BURST switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 10 second ±20%. If the pulse is shorter than 8.0 seconds, replace capacitor C2 on A4. If the pulse is longer than 12 seconds, add a resistor across FIRST BURST control of such a value that it will shorten the pulse to within the specified timing range.

4.5.2 Pause

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1→f2 to In position.

c. Push START switch.

d. Set PAUSE switch to X1 position.

e. Rotate PAUSE control to max ccw position.

f. Connect oscilloscope probe to terminal E30 on Carrier Board A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to the reference voltage (0V) should be 0.1 seconds. If it is not, adjust R7 on A4.

h. Turn PAUSE control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 1.0 seconds ±20%. If the pulse width is less than 0.8 seconds, replace capacitor C3 on A4. If the pulse width is greater than 1.2 seconds, add a resistor across PAUSE control of such a value that it will shorten the pulse to within the specified timing range.

j. Set PAUSE switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 10 seconds ±20%. If the pulse is shorter than 8.0 seconds, replace capacitor C4 on A4. If the pulse is longer than 12.0 seconds, add a resistor across PAUSE control of such a value that it will shorten the pulse to within the specified timing range.

4.5.3 Second Burst

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1→f2 to In position.

c. Push START switch.

d. Set SECOND BURST switch to X1 position.

e. Rotate SECOND BURST control to max ccw position.

f. Connect oscilloscope probe to terminal E21 on A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to reference voltage (0V) should be 0.1 seconds. If it is not, adjust R9 on A4.

h. Rotate SECOND BURST control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 1.0 seconds ±20%. If the pulse width is less than 0.8 seconds, replace capacitor C7 on A4. If the pulse width is greater than 1.2 seconds, add a resistor across SECOND BURST control of such a value that it will shorten the pulse to within the specified timing range.

j. Set SECOND BURST switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 10 seconds ±20%. If the pulse is shorter than 8.0 seconds, replace capacitor C8 on A4. If the pulse length is longer than 12.0 seconds, add a resistor across SECOND BURST control of such a value that it will shorten the pulse to within the specified timing range.

4.5.4 Repeat Delay

a. Push IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

b. Push MODE switch f1→f2 to In position.

c. Push START switch.

d. Set REPEAT DELAY switch to X1 position.

e. Rotate REPEAT DELAY control to max ccw position.

f. Connect oscilloscope probe to terminal E32 on A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to reference voltage (0V) should be 0.5 seconds. If it is not, adjust R8 on A4.

h. Rotate REPEAT DELAY control to max cw position.

i. Observe that the pulse which goes down to reference voltage (0V) is 5 seconds ±20%. If the pulse width is less than 4.0 seconds, replace capacitor C5 on A4. If the pulse width is greater than 6.0 seconds, add a resistor across REPEAT DELAY control of such a value that it will shorten the pulse to within the specified timing range.

j. Turn REPEAT DELAY switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (0V) is 50 seconds ±20%. If the pulse is shorter than 40 seconds, replace capacitor C6 on A4. If the pulse is longer than 60 seconds, add a resistor across REPEAT DELAY control of such a value that it will shorten the pulse to within the specified timing range.

4.6 FREQUENCY ACCURACY TEST

4.6.1 Frequency, f1, Test (all models)

a. Connect 600 Ω OUTPUT of TG-1 to electronic counter.

b. Set the OUTPUT control of TG-1 to maximum cw position.

c. Select MODE f1.

d. Set the thumbwheel switch, f1, to 7777.7 Hz.

e. Set FIRST BURST switch to CONT. position.

f. Set the function switch of electronic counter to "Frequency" 10 kHz.

g. Set the sensitivity of electronic counter to 1.0 position.

h. Reset the counter.

i. Counter should indicate 7.7777 kHz ±0.1 Hz.

j. Set the thumbwheel switch, f1, to 8888.8 Hz.

k. Reset the counter.

l. Counter should indicate 8.8888 kHz ±0.1 Hz.

4.6.2 Frequency, f2, Test (TG-1B, and TG-1C only)

a. Connect 600 Ω OUTPUT of TG-1 to electronic counter.

b. Set the LEVEL control of TG-1 to maximum cw position.

c. Select mode f1 → f2.

d. Set IN-REPEAT/OUT-SINGLE switch to IN-REPEAT position.

e. Set the thumbwheel switch, f2, to 7777.7 Hz. (All other thumbwheels to zero position).

f. Set the FIRST BURST switch to X1 position, and FIRST BURST control to the mid-range position.

g. Set the PAUSE switch to ZERO position.

h. Set the SECOND BURST switch to X10 position, and SECOND BURST control to maximum cw position.

i. Set REPEAT DELAY switch to ZERO position.

j. Set the function switch of electronic counter to "Frequency 10 kHz".

k. Set the sensitivity of electronic counter to 1.0 position.

l. Press START switch of TG-1. At the very beginning of SECOND BURST (light on) reset the counter.

m. Indication should be 7.7777 kHz ±0.1 Hz.

n. Set the thumbwheel switch, f2, to 8888.8 Hz.

o. Indication should be 8.8888 kHz ±0.1 Hz.

4.6.3 Frequency, f3, Test (TG-1B, and TG-1C only)

The procedure for frequency accuracy test is similar to frequency f2 test given in paragraph 4.6.2 with the following exceptions:

a. Select MODE f1, f3.

b. Set the thumbwheel switch, f3, to 7777.7 Hz or 8888.8 Hz.

c. All other thumbwheel switches should be in zero position.

4.6.4 Frequency, f4, Test (TG-1B, and TG-1C only)

a. Connect 600 Ω OUTPUT of TG-1 to electronic counter.

b. Set the LEVEL control of TG-1 to maximum cw position.

c. Select MODE $\begin{bmatrix} f1 \\ f3 \end{bmatrix} \rightarrow \begin{bmatrix} f2 \\ f4 \end{bmatrix}$.

d. Push switch IN-REPEAT/OUT-SINGLE to IN-REPEAT position.

e. Set the thumbwheel switch, f4, (SW18) to 7777.7 Hz. (All other thumbwheels in zero position).

f. Set FIRST BURST switch to X1 position, and FIRST BURST control to the middle position.

g. Set the PAUSE switch to ZERO position.

h. Set the SECOND BURST switch to X10 position, and SECOND BURST control to maximum cw position.

i. Set the REPEAT DELAY switch to ZERO position.

j. Set the function switch of electronic counter to "Frequency 10 kHz".

k. Set the sensitivity of electronic counter to 1.0 position.

l. Press START switch TG-1. At the very beginning of SECOND BURST (light on) reset the counter.

m. Indication should be 7.7777 kHz ±0.1 Hz.

n. Set the thumbwheel switch, f4, (SW18) to 8888.8 Hz.

o. Indication should be 8.8888 kHz ±0.1 Hz.

Section V

SCHEMATIC DIAGRAMS

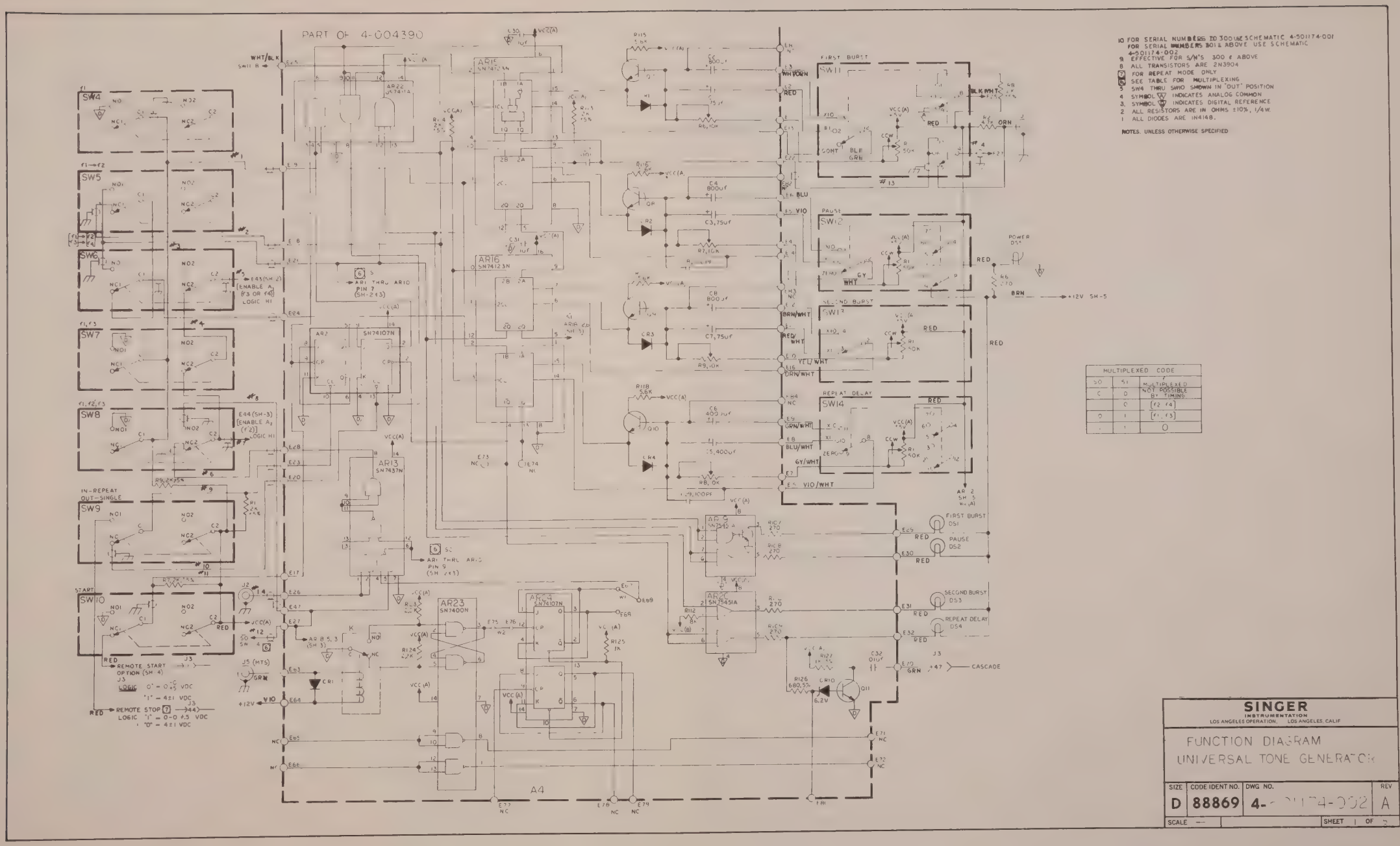
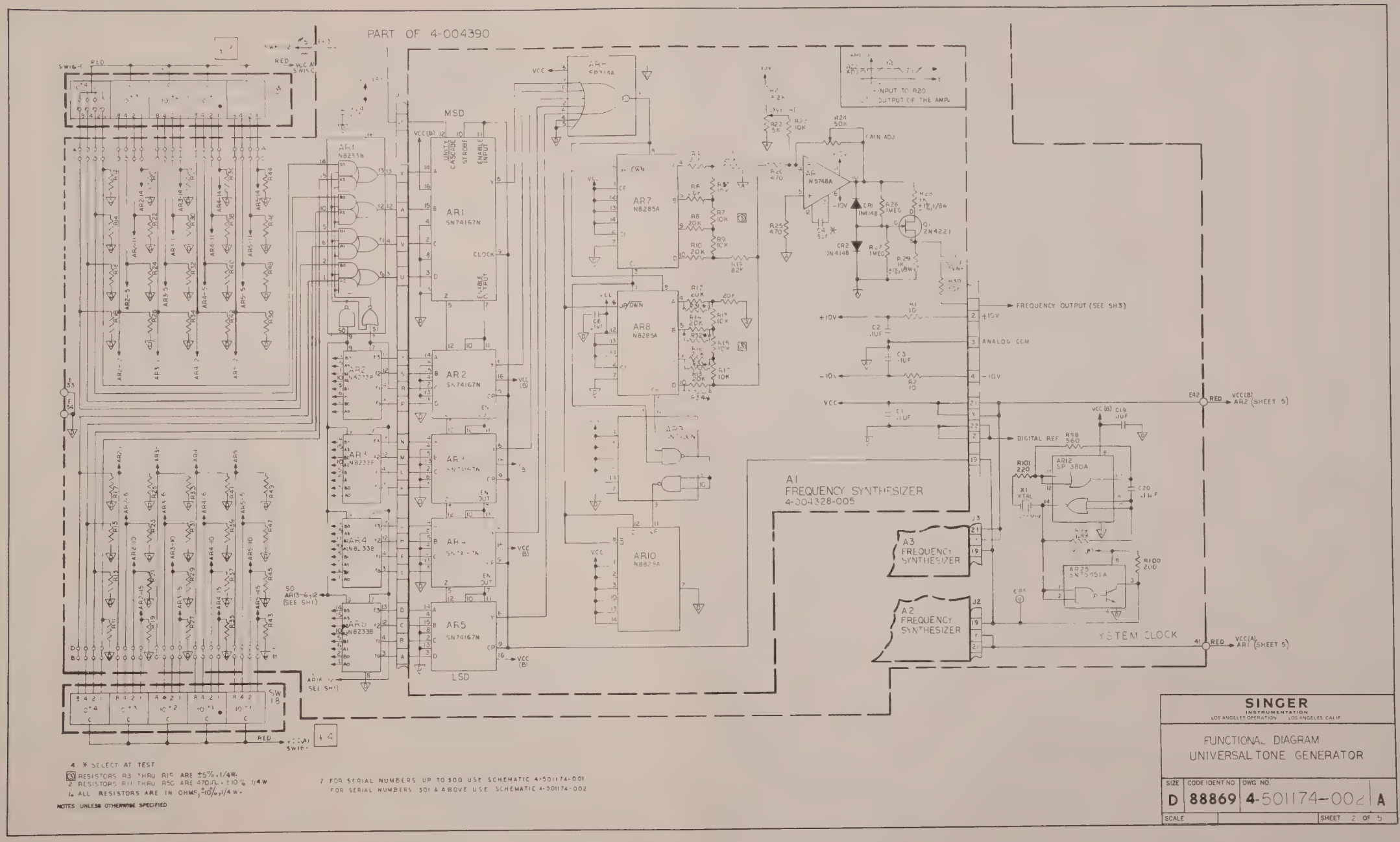

PART OF 4-004390
10 FOR SERIAL NUMBERS TO 300 USE SCHEMATIC 4-501174-001
FOR SERIAL NUMBERS 301 & ABOVE USE SCHEMATIC 4-501174-002
9 EFFECTIVE FOR S/N'S 300 & ABOVE
8 ALL TRANSISTORS ARE 2N3904
7 FOR REPEAT MODE ONLY
6 SEE TABLE FOR MULTIPLEXING
5 SW4 THRU SW10 SHOWN IN 'OUT' POSITION
4 SYMBOL INDICATES ANALOG COMMON
3 SYMBOL INDICATES DIGITAL REFERENCE
2 ALL RESISTORS ARE IN OHMS ±10%, 1/4W.
1 ALL DIODES ARE IN4148.
NOTES: UNLESS OTHERWISE SPECIFIED
MULTIPLEXED CODE
S0 S1 MULTIPLEXED
0 0 NOT POSSIBLE BY TIMING
0 1 (f2 f4)
1 0 (f1 f3)
1 1 0
SINGER
INSTRUMENTATION
LOS ANGELES OPERATION, LOS ANGELES, CALIF
FUNCTION DIAGRAM
UNIVERSAL TONE GENERATOR
SIZE D
CODE IDENT NO. 88869
DWG NO. 4-501174-002
REV A
SCALE —
SHEET 1 OF 5

Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 1 of 5)



4 * SELECT AT TEST

3 RESISTORS R3 THRU R15 ARE ±5%, 1/4W.
2 RESISTORS R11 THRU R56 ARE 470Ω ± 10% 1/4W
1. ALL RESISTORS ARE IN OHMS, ±10%, 1/4 W.

NOTES UNLESS OTHERWISE SPECIFIED

7 FOR SERIAL NUMBERS UP TO 300 USE SCHEMATIC 4-501174-001
FOR SERIAL NUMBERS 301 & ABOVE USE SCHEMATIC 4-501174-002

Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 2 of 5)

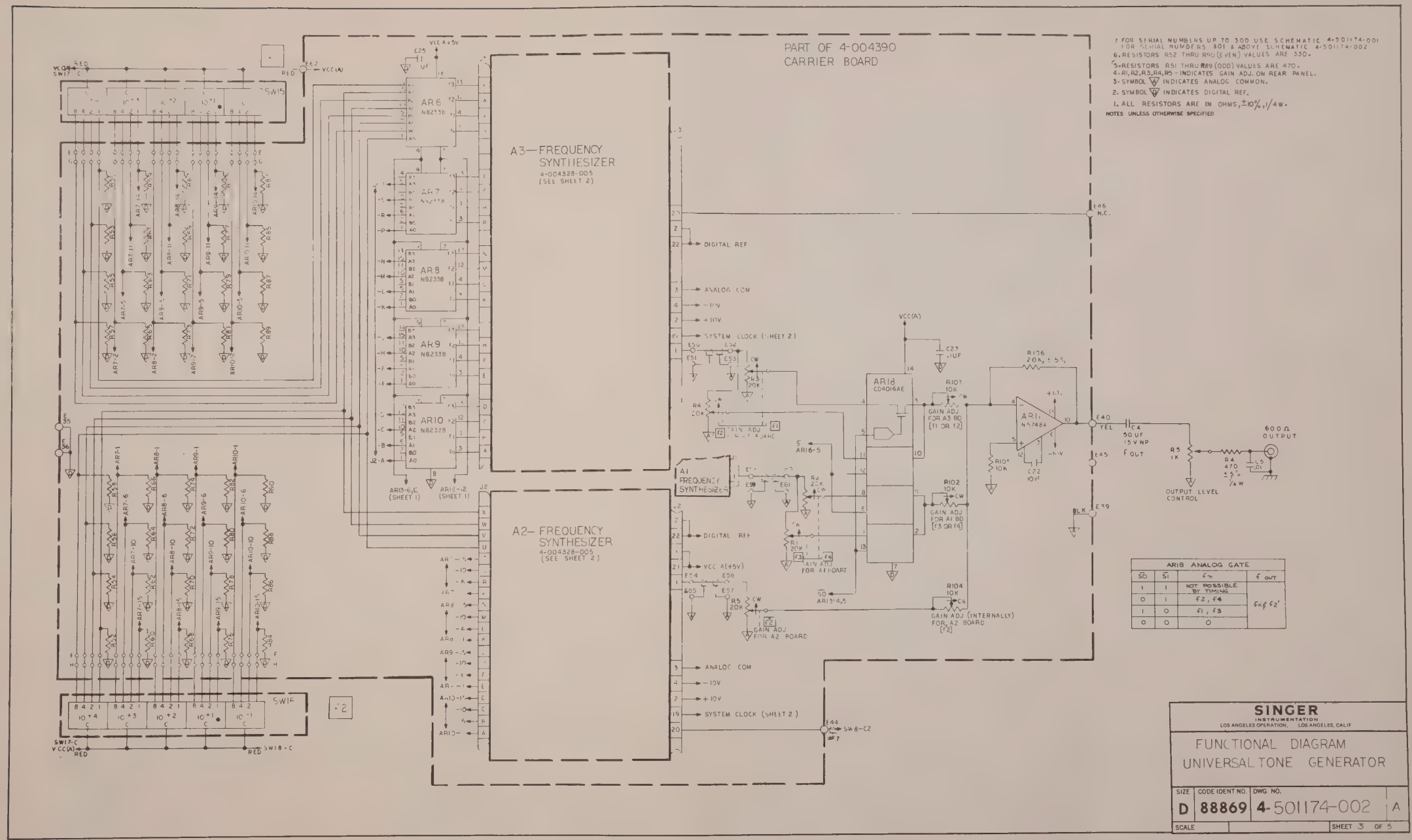
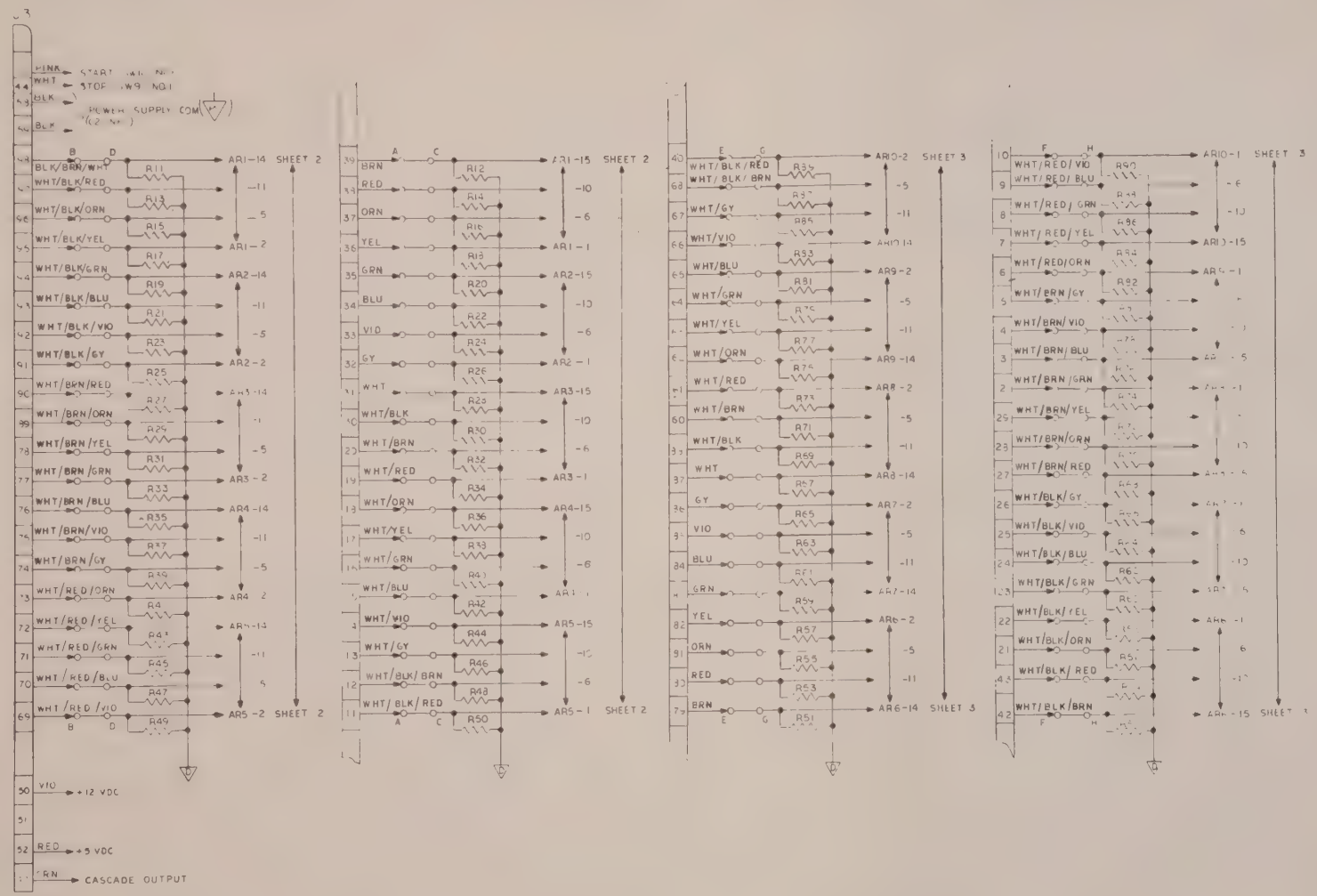


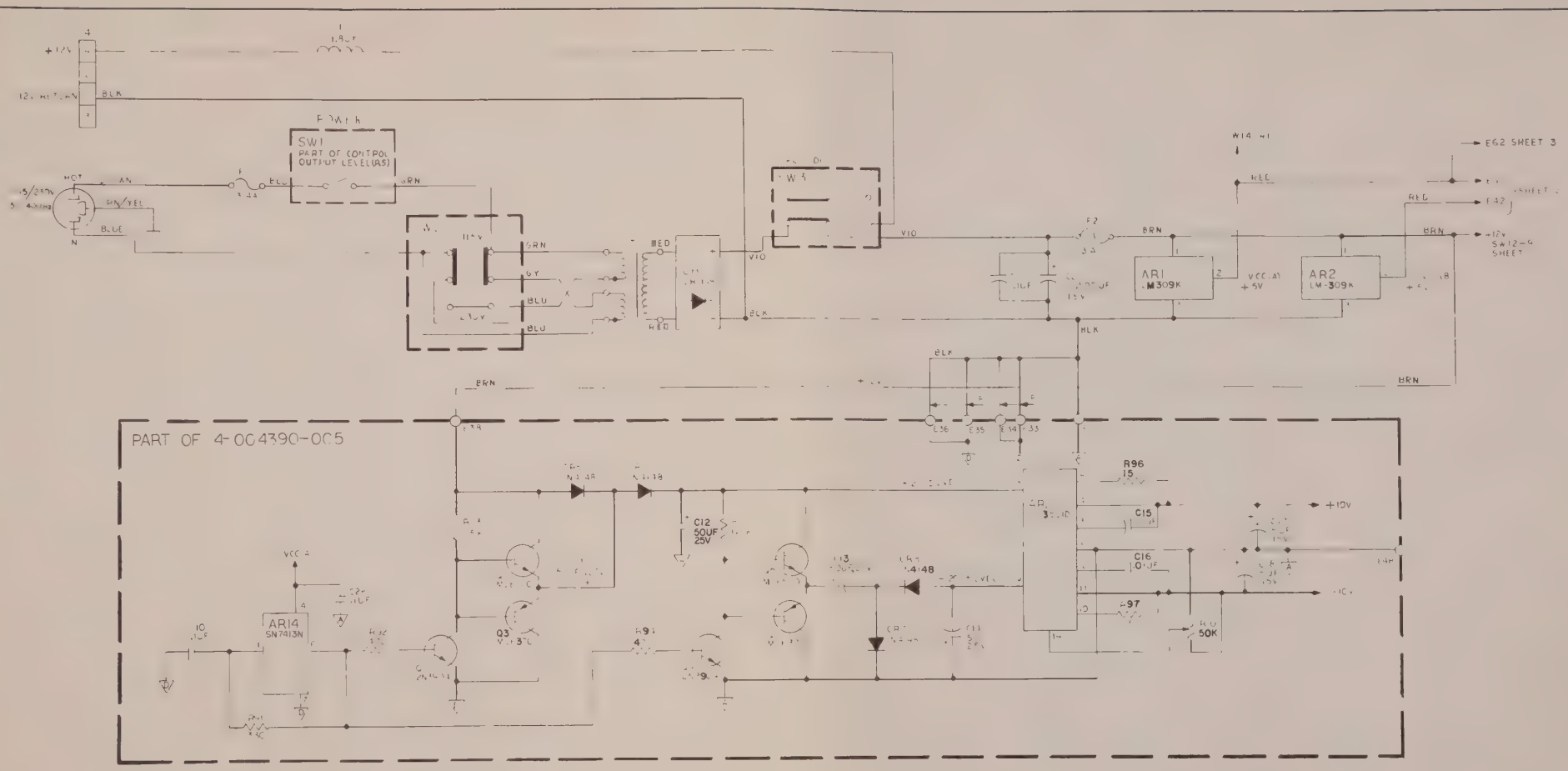
Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 3 of 5)

PARE 41,45,46,48,49, 51, 53, 54,55, 56, 57

4. FOR SERIAL NUMBERS UP TO 300 USE SCHEMATIC 4-501174-001
FOR SERIAL NUMBERS 301 & ABOVE USE SCHEMATIC 4-501174-002
3 FOR RESISTOR VALUE SEE SHEETS 2 AND 3.
2. SYMBOL ▽ INDICATES DIGITAL REFERENCE.
1. SYMBOL ▽PS INDICATES POWER SUPPLY COMMON.

NOTES: UNLESS OTHERWISE SPECIFIED

SINGER INSTRUMENTATION LOS ANGELES OPERATION, LOS ANGELES, CALIF.			
FUNCTIONAL DIAGRAM UNIVERSAL TONE GENERATOR			
SIZE	CODE IDENT NO	DWG NO.	
D	88869	4-501174-002	A
SCALE		SHEET 4 OF 5	

Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 4 of 5)



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS ±10%, 1/4 W.
2. SYMBOL ▽D INDICATES DIGITAL REF.
3. SYMBOL ▽ INDICATES ANALOG COMMON.
4. SYMBOL ⏚ INDICATES CHASSIS GND.
5. SYMBOL ▽PS INDICATES POWER SUPPLY COMMON.
6. FOR SERIAL NUMBERS UP TO 300 USE SCHEMATIC 4-501174-001
   FOR SERIAL NUMBERS 301 & ABOVE USE SCHEMATIC 4-501174-002

SINGER INSTRUMENTATION LOS ANGELES OPERATION LOS ANGELES CALIF			
FUNCTIONAL DIAGRAM UNIVERSAL TONE GENERATOR			
SIZE	CODE IDENT NO	DWG NO.	
D	88869	4-501174-002	A
SCALE		SHEET 5 OF 5	

Figure 5-1. Universal Tone Generator Functional Diagram (Sheet 5 of 5)

Section VI

PARTS LIST

TG-1, TONE GENERATOR, MAJOR ASSEMBLIES, PARTS LIST

REFERENCE DESIGNATOR	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
A1	Frequency Synthesizer Board	4-004328-005		
A2	Same as A1			
A3	Same as A1			
A4	Carrier Board	4-004390-008		

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST

REFERENCE DESIGNATOR	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
AR1	Integrated circuit, +5 VDC regulator	1-926038-002	NS	LM-309K
AR2	Same as AR1			
C1	Capacitor, met plastic 0.1 μf	1-900001-013	Amperex	C280AE
C2	Capacitor, elect, 10,500 μf	1-900073-002	Mallory	CG1052015K1
C3	Same as C1			
C4	Capacitor, elect, 50 μf, 15VNP	1-900060-001	GI	98416NP
C5	Capacitor, met plastic, 0.01 μf	1-900001-001	Amperex	C280AE
CR1	Diode bridge rect, epoxy	1-913040-001	Varo	VH148TT
DS1	Indicator light (green)	1-925006-002	Mura	L-10/20
DS2	Same as DS1			
DS3	Same as DS1			
DS4	Same as DS1			
DS5	Indicator light (red)	1-925007-003	Mura	L-10/20
F1	Fuse, 3/4A	1-924000-017	Bussmann	Type MDL
F2	Fuse, 3A	1-924000-027	Bussmann	Type MDL
J1	Jack, phone	1-910026-001	Switchcraft	Type 3C1054A
J2	Same as J1			
J3	Connector, receptacle	1-910194-002	Singer	1-910194-002
P3 Mate	Connector, plug	1-910194-001	Singer	1-910194-001
J4	Connector, plug	1-910179-002	Cinch Jones	P-304-DB
J5	Same as J1			
L1	Choke, 1.8 μf	1-906009-001		
P1	Cord, power	1-910166-001	Belden	KH7375

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST (contd)

REFERENCE DESIGNATOR	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
R1	Resistor, comp, 2K ±5%, 1/4w	1-945000-169	Allen Bradley	Type CB
R2	Resistor, comp, 4.7K ±10%, 1/4w	1-945000-045	Allen Bradley	Type CB
R3	Not used			
R4	Resistor, 470 ohms ±5%, 1/4w	1-945000-154	Allen Bradley	Type CB
R5	Resistor, variable 1K pot/switch S1	1-403343-001	Allen Bradley	Type CB
R6	Resistor, comp, 270 ohms ±10%, 1/4w	1-945000-030	Allen Bradley	Type CB
R7	Same as R1			
R8	Same as R1			
R9	Same as R1			
S1	Switch/variable resistor (see R5)			
S2	Switch, slide (115/230)	1-951003-001	Switchcraft	Type 46206LF
S3	Switch, slide (AC-DC)	1-951003-001	Switchcraft	Type 46206LF
S4	Switch, pushbutton assembly	1-951020-002	IEE	TXF17.5SB/ BLK-2U-GR
S5	Same as S4			
S6	Same as S4			
S7	Same as S4			
S8	Same as S4			
S9	Same as S4			
S10	Same as S4			
S11	Switch, pot concentric	1-003407-004		
S12	Same as S11			
S13	Switch, pot concentric	1-003407-005		
S14	Same as S11			
S15	Thumbwheel Switch	1-951039-001	Digitran	29-5-2
S16	Same as S15			
S17	Same as S15			
S18	Same as S15			
T1	Transformer, power	1-403314-001		

TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST

REFERENCE DESIGNATOR	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
AR1	Integrated cct, decade rate scaler	1-926007-011	TI	SN74167N
AR2	Same as AR1			
AR3	Same as AR1			
AR4	Same as AR1			
AR5	Same as AR1			
AR6	Integrated cct, 7-input nor gate	1-926018-003	Signetics	SP314A
AR7	Integrated cct, decade up/down counter	1-926047-003	Signetics	N8285A
AR8	Same as AR7			
AR9	Integrated cct, 2-input nand gate	1-926007-001	TI	SN7400N
AR10	Integrated cct, D-input F.F.	1-926047-001	Signetics	N8828N
AR11	Integrated cct, operational amplifier	1-926048-001	Signetics	N5748A
C1	Capacitor, net plastics, 0.1 μf	1-900001-013	Amperex	C280AE
C2	Same as C1			
C3	Same as C1			
C4	Capacitor, dipped mica(5 AT)5 pF	1-900003-004	EMM	DM15
C5	Capacitor, elect, non-polar 50 μf, 15V	1-900060-001	GI	984-16NP
C6	Same as C1			
CR1	Diode	1-913007-002		1N4148
CR2	Same as CR1			
Q1	Transistor, field effect	1-958052-001	Motorola	2N4221
R1	Resistor, comp, 10 ohm ±10%, 1/4w	1-945000-013	Allen Bradley	Type CB
R2	Same as R1			
R3	Resistor, comp, 20K±5%, 1/4w	1-945000-193	Allen Bradley	Type CB
R4	Same as R3			
R5	Resistor, film, 10K±1%, 1/8w	1-945016-289		
R6	Same as R3			
R7	Resistor, comp, 10K±5%, 1/4w	1-945000-186	Allen Bradley	Type CB
R8	Same as R3			
R9	Same as R5			
R10	Same as R3			

TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST (contd)

REFERENCE DESIGNATOR	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
R11	Same as R3			
R12	Same as R3			
R13	Same as R7			
R14	Same as R3			
R15	Same as R7			
R16	Same as R3			
R17	Same as R7			
R18	Same as R3			
R19	Resistor, comp, 82K ±5%, 1/4w	1-945000-208	Allen Bradley	Type CB
R20	Resistor, comp, 470 ohms ±10%, 1/4w	1-945000-033	Allen Bradley	Type CB
R21	Resistor, comp, 8.2K ±10%, 1/4w	1-945000-048	Allen Bradley	Type CB
R22	Resistor, variable 20 turn 5K	1-945093-001		
R23	Resistor, comp, 10K ±10%, 1/4w	1-945000-049	Allen Bradley	Type CB
R24	Resistor, variable, 50K	1-956010-009	CTS	Type 201
R25	Same as R20			
R26	Resistor, comp, 1 Meg ±10%, 1/4w	1-945000-073	Allen Bradley	Type CB
R27	Same as R26			
R28	Resistor, film 1K ±10%, 1/8w	1-945016-193		
R29	Same as R28			
R30	Same as R23			
R31	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB
R32	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB
R33	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB
R34	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

REFERENCE DESIG.	APPLICABLE MODELS	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
AR1	TG-1B -1C -1BP -1CP	Integrated cct, 2-input 4 Bit Digital multiplexer	1-926047-002	Signetics	N8233B
AR2	TG-1B -1C -1BP -1CP	Same as AR1			
AR3	TG-1B -1C -1BP -1CP	Same as AR1			
AR4	TG-1B -1C -1BP -1CP	Same as AR1			
AR5	TG-1B -1C -1BP -1CP	Same as AR1			
AR6	All	Same as AR1			
AR7	All	Same as AR1			
AR8	All	Same as AR1			
AR9	All	Same as AR1			
AR10	All	Same as AR1			
AR11	All	Integrated cct, operational amplifier	1-926048-001	Signetics	N5748A
AR12	All	Integrated cct, 2-input positive nand gate	1-926018-002	Signetics	SP380A
AR13	All	Integrated cct, 2-input positive nand gate	1-926007-006	TI	SN7437N
AR14	All	Integrated cct, dual nand schmitt trigger	1-926007-005	TI	SN7413N
AR15	All	Integrated cct, retriggerable monostable multivibrator with clear	1-926007-007	TI	SN74123N
AR16	All	Same as AR15			
AR17	All	Integrated cct, ±10 VDC regulator	1-926049-001	Signetics	SG3501D
AR18	All	Integrated cct, quad spst mos analog switch	1-926050-001	RCA	CD4016AE
AR19	All	Integrated cct, dual positive and driver	1-926051-001	TI	SN75451A
AR20	All	Same as AR19			
AR21	All	Integrated cct, J-K input flip-flop	1-926007-012	TI	SN74107N
AR22	All	Integrated cct, 3-input and gate	1-926053-001	Sprague	US7411A
AR23	All	Integrated cct, 2-input nand gate	1-926007-001	TI	SN7400N
AR24	All	Same as AR21			

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

REFERENCE DESIG.	APPLICABLE MODELS	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
AR25	All	Integrated cct	1-926051-001	TI	SN75951A
C1	All	Capacitor, elect, 75 µf ±10% 3V	1-900106-001	Callins	2-85-ASD-75-3NP
C2	All	Capacitor, elect, 800 µf ±10% 3V	1-900106-002	Callins	12-85-ASD-800-3NP
C3	All	Same as C1			
C4	All	Same as C2			
C5	All	Capacitor, elect, 400 µf ±10% 3V	1-900106-003	Callins	8-85-ADS-400-3NP
C6	All	Capacitor, elect, 4000 µf ±10% 3V	1-900107-001	Callins	10-85-PSD-4000-3NP
C7	All	Same as C1			
C8	All	Same as C2			
C9		Not used			
C10	All	Capacitor, met plastic, 0.1 µf	1-900001-013	Amperex	C280AE
C11	All	Capacitor, elect, 50 µf, 25V	1-900039-005	GI	984-122
C12	All	Same as C11			
C13	All	Same as C11			
C14	All	Same as C11			
C15	All	Capacitor, met plastic, 0.1 µf	1-900001-001	Amperex	C280AE
C16	All	Same as C15			
C17	All	Capacitor, elect, 5 µf, 15V	1-900039-007	GI	984-9
C18	All	Same as C17			
C19	All	Same as C10			
C20	All	Same as C10			
C21	All	Not Used			
C22	All	Capacitor, mica, 10 pF ±5% 500V	1-900003-008	EMM	DM15
C23	All	Same as C10			
C24	All	Same as C10			
C25	All	Same as C10			
C26	All	Same as C10			
C27	All	Capacitor, mica, 1000pF ±5%	1-900003-056	EMM	DM15
C28	All	Capacitor, mica, 100pF ±5%	1-900003-030	EMM	DM15
C29	All	Same as C28			
C32	All	Same as C15			

REFERENCE DESIG.	APPLICABLE MODELS	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
CR1	All	Diode, Silicon	1-913007-002		1N4148
CR2	All	Same as CR1			
CR3	All	Same as CR1			
CR4	All	Same as CR1			
CR5	All	Same as CR1			
CR6	All	Same as CR1			
CR7	All	Same as CR1			
CR8	All	Same as CR1			
CR9		Not used			
CR10	All	Zener 6.2V	1-913003-212		
CR11	All	Same as CR1			
J1	All	Connector, PC board	1-910105-006	USC	UPCRD22ST1
J2	All	Same as J1			
J3	All	Same as J1			
Q1	All	Transistor, NPN-silicon	1-958000-001	Motorola	2N3904-5
Q2	All	Transistor, NPN-silicon	1-958001-002	Motorola	MJE520
Q3	All	Transistor, PNP-silicon	1-958001-001	Motorola	MJE370
Q4	All	Same as Q1			
Q5	All	Same as Q3			
Q6	All	Same as Q2			
Q7	All	Same as Q1			
Q8	All	Same as Q1			
Q9	All	Same as Q1			
Q10	All	Same as Q1			
Q11	All	Same as Q1			
R1	All	Resistor, variable 20K	2-403320-001		
R2	All	Same as R1			
R3	All	Same as R1			
R4	All	Same as R1			
R5	All	Same as R1			
R6	All	Resistor, variable 10K	1-945007-007	CTS	Type X201
R7	All	Same as R6			
R8	All	Same as R6			
R9	All	Same as R6			
R10	All	Resistor, variable 50K	1-945007-009	CTS	Type X201
R11	All	Resistor, comp, 470 ohm ±10%, 1/4w	1-945000-033	Allen Bradley	Type CB

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

REFERENCE DESIG.	APPLICABLE MODELS	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
R12	All	Same as R11			
R13	All	Same as R11			
R14	All	Same as R11			
R15	All	Same as R11			
R16	All	Same as R11			
R17	All	Same as R11			
R18	All	Same as R11			
R19	All	Same as R11			
R20	All	Same as R11			
R21	All	Same as R11			
R22	All	Same as R11			
R23	All	Same as R11			
R24	All	Same as R11			
R25	All	Same as R11			
R26	All	Same as R11			
R27	All	Same as R11			
R28	All	Same as R11			
R29	All	Same as R11			
R30	All	Same as R11			
R31	All	Same as R11			
R32	All	Same as R11			
R33	All	Same as R11			
R34	All	Same as R11			
R35	All	Same as R11			
R36	All	Same as R11			
R37	All	Same as R11			
R38	All	Same as R11			
R39	All	Same as R11			
R40	All	Same as R11			
R41	All	Same as R11			
R42	All	Same as R11			
R43	All	Same as R11			
R44	All	Same as R11			

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

REFERENCE DESIG.	APPLICABLE MODELS	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
R45	All	Same as R11			
R46	All	Same as R11			
R47	All	Same as R11			
R48	All	Same as R11			
R49	All	Same as R11			
R50	All	Same as R11			
R51	All	Same as R11			
R52	All	Resistor, comp, 330 ohm ±10%, 1/4w	1-945000-031	Allen Bradley	Type CB
R53	All	Same as R11			
R54	All	Same as R52			
R55	All	Same as R11			
R56	All	Same as R52			
R57	All	Same as R11			
R58	All	Same as R52			
R59	All	Same as R11			
R60	All	Same as R52			
R61	All	Same as R11			
R62	All	Same as R52			
R63	All	Same as R11			
R64	All	Same as R52			
R65	All	Same as R11			
R66	All	Same as R52			
R67	All	Same as R11			
R68	All	Same as R52			
R69	All	Same as R11			
R70	All	Same as R52			
R71	All	Same as R11			
R72	All	Same as R52			
R73	All	Same as R11			
R74	All	Same as R52			
R75	All	Same as R11			
R76	All	Same as R52			

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

REFERENCE DESIG.	APPLICABLE MODELS	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
R77	All	Same as R11			
R78	All	Same as R52			
R79	All	Same as R11			
R80	All	Same as R52			
R81	All	Same as R11			
R82	All	Same as R52			
R83	All	Same as R11			
R84	All	Same as R52			
R85	All	Same as R11			
R86	All	Same as R52			
R87	All	Same as R11			
R88	All	Same as R52			
R89	All	Same as R11			
R90	All	Same as R52			
R91	All	Same as R52			
R92	All	Same as R11			
R93	All	Resistor, comp, 1.5K ±10%, 1/4w	1-945000-039	Allen Bradley	Type CB
R94	All	Same as R11			
R95	All	Same as R93			
R96	All	Resistor, comp, 50 ohm ±5%, 1/4w	1-945000-015		
R97	All	Same as R96			
R98	All	Resistor, comp, 560 ohm ±5%, 1/4w	1-945000-156	Allen Bradley	Type CB
R99	All	Resistor, comp, 1.8K ohm ±5%, 1/4w	1-945000-186	Allen Bradley	Type CB
R100	All	Resistor, comp, 200 ohm ±5%, 1/4w	1-945000-145	Allen Bradley	Type CB
R101	All	Resistor, comp, 220 ohm ±5%, 1/4w	1-945000-146	Allen Bradley	Type CB
R102	All	Same as R6			
R103	All	Same as R6			
R104	All	Same as R6			
R105	All	Resistor, comp, 10K ±10%, 1/4w	1-945000-049	Allen Bradley	Type CB

REFERENCE DESIG.	APPLICABLE MODELS	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MANUFACTURER PART NUMBER
R106	All	Resistor, comp, 20K ±10%, 1/4w	1-945000-193	Allen Bradley	Type CB
R107	All	Resistor, comp, 270 ohm ±10%, 1/4w	1-945000-030	Allen Bradley	Type CB
R108	All	Same as R107			
R109	All	Same as R107			
R110	All	Same as R107			
R111		Not used			
R112	All	Resistor, comp, 1.8K ±5%, 1/4w	1-945000-168		
R113	All	Resistor, comp, 2K ±10%, 1/4w	1-945000-041		
R114	All	Resistor, comp, 2K ±5%, 1/4w	1-945000-169		
R115	All	Resistor, comp, 22K ±5%, 1/4w	1-945001-194		
R116	All	Same as R115			
R117	All	Same as R115			
R118	All	Same as R115			
R119	All	Not used			
R120	All	Not used			
R121	All	Not used			
R122	All	Not used			
R123	All	Same as R113			
R124	All	Same as R113			
R125	All	Resistor, comp, 1K ±5%, 1/4w	1-945000-037		
R126	All	Resistor, comp, 680 ohm ±5%, 1/4w	1-945000-158		
R127	All	Same as R125			
K1	All	Relay	1-942014-003		
XAR1 thru XAR5	All	Socket, Dual in-line	1-950015-001		
XAR15	All	Same as XAR1 thru XAR5			
XAR16	All	Same as XAR1 thru XAR5			
XAR21	All	Socket, Dual in-line	1-950014-001	Augat, Inc	314AG502R
XAR22	All	Same as XAR21			
X1	All	Crystal; 1.98 MHz	1-403317-001		

APPENDIX A

INSTALLATION PROCEDURE FOR UPGRADING TG-1

A.1 INTRODUCTION

TG-1 may be upgraded in the field using factory prewired kits as follows:

FROM	TO	KIT NUMBER
TG-1A	TG-1B	1-004649-001
TG-1A	TG-1C	1-004650-001
TG-1B	TG-1C	4-004328-005
TG-1 (A, B or C)	TG-1 (A, B or C) P	1-004655-001

A.2 UPGRADING TG-1A TO TG-1B (KIT NO. 1-004649-001)

a. Five integrated circuits N8233B plug into the sockets A4AR1 - A4AR5 on the Carrier Board (A4).

b. Remove cover on the front panel for f3 thumbwheel switch.

c. Install prewired thumbwheel (Harness No. 1).

d. Remove cover on the front panel for f4 thumbwheel switch.

e. Install prewired thumbwheel (Harness No. 2).

f. The amp terminals from the wires should be plugged on the Carrier Board terminals as shown in Figure 5-1, sheet 2.

g. Frequency synthesizer board (A1) (4-004328-005) plugs into the connector J1 on the Carrier Board (A4).

h. Perform calibration procedure described in paragraph 4.4.1.

A.3 UPGRADING TG-1A to TG-1C (KIT NO. 1-004650-001)

a. Same as paragraph A-2 (a to g) above.

b. Frequency synthesizer board (A2) (4-004328-005) plugs into the connector J2 on the Carrier Board (A4).

c. Perform calibration procedure described in paragraphs 4.4.2 and 4.4.3.

A.4 UPGRADING TG-1B TO TG-1C (KIT NO. 4-004328-005)

a. Frequency synthesizer board (A2) (4-004328-005) plugs into the connector J2 on the Carrier Board (A4).

b. Perform calibration procedure described in paragraph 4.4.3.

A.5 UPGRADING TG-1A, B, OR C TO PROGRAMMABLE UNIT (KIT NO. 1-004655-001)

a. Remove cover on the rear panel for J3 connector.

b. Install prewired connector.

c. The amp terminals from the wires should be plugged onto the Carrier Board terminals as shown in Figure 5-1, sheet 4.

d. Set all front panel thumbwheel switches to zero position.

e. Perform calibration procedure described in paragraph 4.6 using remote switches.

A.6 UPGRADING TG-1B FOR IMTS, MTS AND SECODE OUTPUT

The Universal Tone Generator TG-1B has the capability of producing all tone modes except three frequencies simultaneously (f1, f2', f3), Secode, MTS and IMTS because f2' cannot be generated. Frequency f2' cannot be generated because the unit does not contain an A2 frequency synthesizer board, (Singer P/N 4-004328-005). To convert the TG-1B for IMTS, MTS, and Secode operation, either one of two modifications may be made.

1. Add one new frequency synthesizer board to J2 connector. This modification converts TG-1B to TG-1C which has full capability.

2. Transfer frequency synthesizer board A1 (J1) to connector J2. Thus, the modified TG-1B is capable of generating f2' and therefore IMTS, MTS, and Secode. However, the TG-1B loses some of its standard capability.

Frequencies f3 and f4 cannot be generated and therefore, only the following modes may be performed: Single-tone f1; two-tone sequential f1 → f2; and two-tone simultaneous f1, f2'. Figure A-1 shows how to modify TG-1B, by transferring A1 to A2.

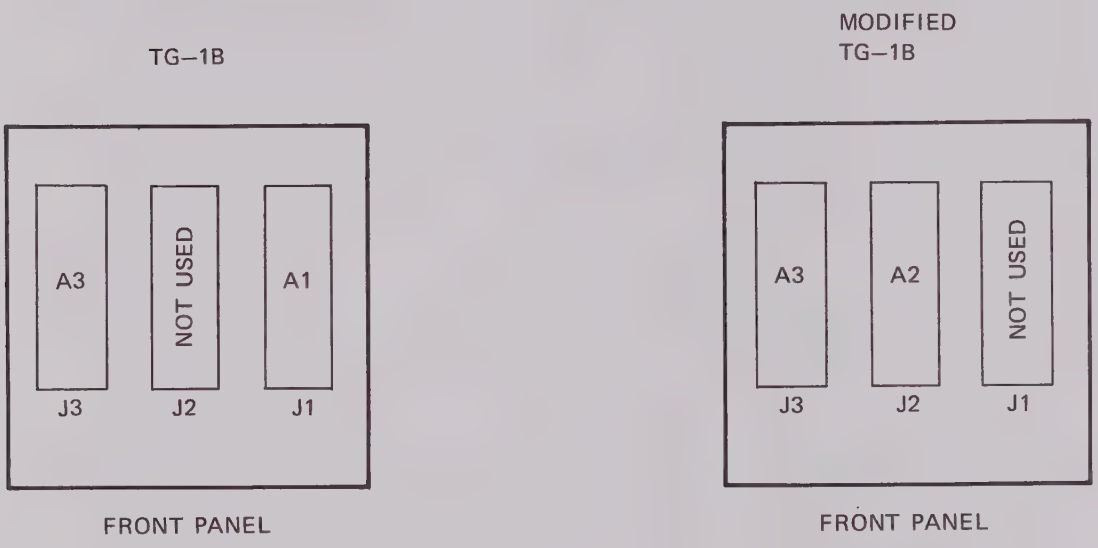


Figure A1. Modifying Model TG-1B for IMTS, MTS and Secode Output

ADDENDUM
For
Manual No. 1-500783-261
Model TG-1

Running Changes

Perform the following changes to the above manual

Effective serial number 301 and above
Effective date June 12, 1973

Page 5-11/5-12:

Figure 5-1. Universal Tone Generator Function Diagram
R96, R97, Was: 15
Is: 10

Page 6-11:

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

Was:

R96	All	Resistor, comp., 50 ohm ±5%, 1/4 W	1-945000-015	------	-------

Is:

R96	All	Resistor, comp., 10 ohm ±10%, 1/4 W	1-945000-013	Allen-Bradley Type CB

REVISED

APPROVED D.M. 8/2

SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL TG-1	DWG NO. 1- 500783-261 (1) SHEET 2 OF 2

FORM NO. 142 1M 3-70 D-H

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CHANGE NOTICE SUMMARY

Revision	Reason for Change	Date of Change

85887